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NATIONALGEOGRAPHIC.COM/MAGAZINE DECEMBER 2006

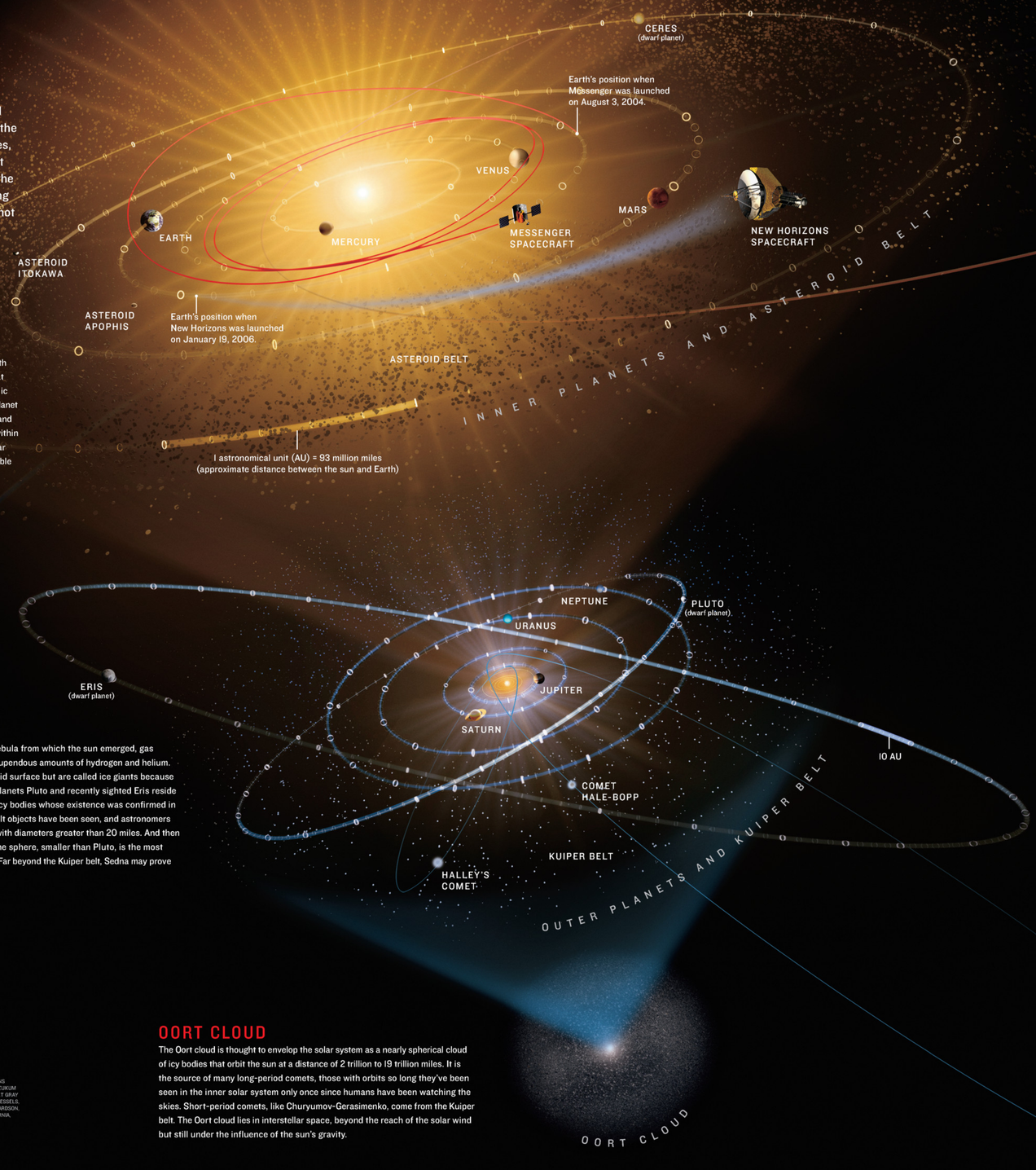
NATIONAL GEOGRAPHIC

Saturn
As You've Never Seen It

19 TRILLION MILES TO EXPLORE

It's a whole new solar system. Far-flung robotic missions and more powerful telescopes keep changing our perspective of the cosmic neighborhood. Here is the solar system in three scales, including the Oort cloud, never directly observed but thought to surround the system out to perhaps 19 trillion miles from the sun. All these parts coalesced from material thrown off during the birth of our star 4.6 billion years ago. This art is a snapshot of where everything in orbit stood on December 1, 2006.

Planet sizes not to scale



INNER PLANETS

Mercury, Venus, Earth, and Mars are terrestrial planets, solid spheres of rock with metallic cores. Because they formed close to the young sun, the tremendous heat of creation evaporated their gases, leaving dense airless planets. Gassy volcanic eruptions on all but Mercury later created atmospheres. Newly designated dwarf planet Ceres is largest of the million plus rocky bodies in the asteroid belt between Mars and Jupiter. Scientists were recently surprised to discover three icy comets orbiting within the asteroid belt. They appear to have formed there rather than in the outer solar system beyond Neptune, like most comets. Since they contain water ice, it's possible that such asteroid belt comets brought water to Earth.

OUTER PLANETS

Born in cooler parts of the swirling nebula from which the sun emerged, gas giants Jupiter and Saturn swept up stupendous amounts of hydrogen and helium. Uranus and Neptune also have no solid surface but are called ice giants because they are largely rock and ice. Dwarf planets Pluto and recently sighted Eris reside in the Kuiper belt—a realm of rocky, icy bodies whose existence was confirmed in 1992. More than a thousand Kuiper belt objects have been seen, and astronomers anticipate there are 500,000 others with diameters greater than 20 miles. And then there's Sedna: Discovered in 2003, the sphere, smaller than Pluto, is the most distant solar system object ever seen. Far beyond the Kuiper belt, Sedna may prove to be part of the inner Oort cloud.

OORT CLOUD

The Oort cloud is thought to envelop the solar system as a nearly spherical cloud of icy bodies that orbit the sun at a distance of 2 trillion to 19 trillion miles. It is the source of many long-period comets, those with orbits so long they've been seen in the inner solar system only once since humans have been watching the skies. Short-period comets, like Churyumov-Gerasimenko, come from the Kuiper belt. The Oort cloud lies in interstellar space, beyond the reach of the solar wind but still under the influence of the sun's gravity.

ONGOING DISCOVERIES

SEARCHING FOR WATER

The biochemistry of life as we know it requires liquid water. Does it exist anywhere but Earth? Mars has frozen water at the poles (crater, below) and under the surface at high latitudes. Jupiter's moon Europa may conceal a liquid ocean miles beneath its H_2O ice surface. Most tantalizing: On Saturn's moon Enceladus, liquid water may feed the plumes of vapor and ice particles shooting hundreds of miles into space.

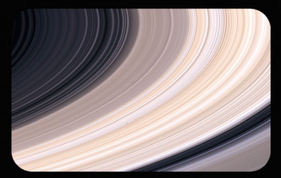
Image Not Available

MOONS RISING

The moon count for our solar system is now more than 170 and expected to grow. The current Cassini mission, for instance, has added four moons to Saturn. The first asteroid moon was confirmed in 1993 (several asteroids are now known to have them), and in 2005 the asteroid 87 Sylvia was found to have two moons, named Romulus and Remus. A number of Kuiper belt bodies in addition to Pluto and Eris have moons.

DYNAMIC RINGSCAPES

Images from the Cassini mission to Saturn (below) confirm that one band of rings is sustained by ice from the geyserlike plumes of the moon Enceladus. The outermost of Neptune's five faint rings displayed arcs—bright concentrations of embedded material—when Voyager 2 flew by in 1989. Telescope views now show the arcs decaying and migrating, and scientists want to learn why.

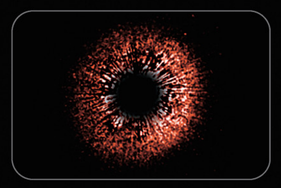


INCOMING

The asteroid 99942 Apophis, the Greek name for an Egyptian god of destruction, is classified as a near-Earth object. Discovered in 2004, it crosses Earth's orbit twice during its own 323-day orbit and caused a stir when it seemed it might pass dangerously close in 2029. It's no longer considered a threat, and none of the 4,000 known near-Earth objects are predicted to come close enough for concern in the 21st century.

OTHER SOLAR SYSTEMS

It looks like an eye's iris (below)—a debris disk encircling the star HD 107146. Our Kuiper belt, the disk of planetary debris beyond Neptune, might look similar, though much narrower, if viewed from another star. The star in this false-color image is obscured to make the cloud visible. It's similar to our sun but four billion years younger, with no known planets yet formed from its dust. But other solar systems—very different from our own—are out there: Since 1995, some 200 planets have been discovered around other stars.



SUPPLEMENT TO NATIONAL GEOGRAPHIC. DECEMBER 2006

ART: MOONRUNNER DESIGN AND CHARLES L. FLOYD. **SOURCES:** NASA/JPL SOLAR SYSTEM DYNAMICS GROUP (ORBITS); NASA/JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY (SPACECRAFT TRAJECTORIES). **IMAGES:** ESA/DLR/FU BERLIN, GERHARD NEUKUM (MARS); NASA/JPL/SPACE SCIENCE CENTER (SATURN); NASA AND ESA (DEBRIS DISK); JAXA (ASTEROID ITOKAWA). **DESIGN:** ROBERT GRAY AND JEFFREY L. OSBORN. **RESEARCH:** PATRICIA KELLOGG. **PRODUCTION:** DIANNE HUNT. **TEXT:** CHRIS CARROLL, AUTHOR; JANE VESSELS, EDITOR; MARY JENNINGS LUGER, RESEARCHER. **CONSULTANTS:** PAUL W. CHODAS AND DONALD K. YEOMANS, NASA/JPL; DEREK C. RICHARDSON, UNIVERSITY OF MARYLAND; MICHAEL E. BROWN, CALIFORNIA INSTITUTE OF TECHNOLOGY; IMKE DE PATER, UNIVERSITY OF CALIFORNIA, BERKELEY; DANIEL MÜLLER, EUROPEAN SPACE AGENCY

MISSIONS TO FIND MORE

MERCURY

MESSENGER—NASA
Launch 8/3/2004; Mercury orbit 3/18/2011
Messenger will orbit Mercury for one Earth year, mapping the surface and gathering data to illuminate how this least explored of the inner planets was formed.

VENUS

VENUS EXPRESS—EUROPEAN SPACE AGENCY (ESA)
Launch 11/9/2005; Venus orbit 4/11/2006
The ESA's first mission to Venus is surveying the planet's atmosphere over the course of two Venusian days (almost 500 Earth days).

MARS

MARS RECONNAISSANCE ORBITER—NASA
Launch 8/12/2005; Mars orbit 3/10/2006
The history of water on Mars is this orbiter's top priority. It is seeking ancient shorelines and minerals generated by long exposure to water. It will also gather data to determine if underground ice detected by other orbiters extends deeply or is just a layer beneath the surface.

ASTEROIDS

HAYABUSA—JAPAN
Launch 5/9/2003; landed on asteroid Itokawa and collected sample 11/28/2005
Hayabusa is expected to return to Earth in June 2010 with samples from the asteroid Itokawa (below). If asteroids are, as thought, material that was unable to coalesce into planets, this mission could shed light on the formative years of the solar system.

SATURN

CASSINI-HUYGENS—NASA, EUROPEAN SPACE AGENCY, ITALIAN SPACE AGENCY
Launch 10/15/1997; Saturn orbit 6/30/2004; Huygens landed on Titan 1/14/2005
Studying Saturn's moons, its atmosphere, its magnetism, and its icy rings are primary objectives of this collaborative mission. The Cassini orbiter released the Huygens probe, which landed on Titan, Saturn's largest moon, perhaps reminiscent of early Earth, though too cold for life.

PLUTO

NEW HORIZONS—NASA
Launch 1/19/2006; Pluto close approach 7/14/2015; Kuiper belt object encounters 2016-2020
New Horizons is the first mission to Pluto and its moons, Charon, Hydra, and Nix. It will study surface composition and temperature—and perhaps find rings—then push farther into the still little-understood Kuiper belt.

COMETS

ROSETTA—EUROPEAN SPACE AGENCY
Launch 3/2/2004; reach comet Churyumov-Gerasimenko in spring 2014
Could life on Earth have been "seeded" by a comet? Rosetta will be the first spacecraft to enter into orbit around a comet, which it will monitor approaching the sun. A lander on the orbiter will attempt touchdown.

THE FINAL FRONTIER

VOYAGER 1 AND 2—NASA
Having radically expanded our knowledge of Jupiter, Saturn, Uranus, and Neptune, Voyager 1 and Voyager 2, both launched in 1977, are nearing the edge of the sun's magnetic domain, where the stream of charged particles called the solar wind meets the wind of interstellar space. Voyager 1, on a faster track, is now more than nine billion miles from the sun, yet still an estimated ten years from entering interstellar space—and 6,000 years from the inner edge of the Oort cloud.

THE SOLAR SYSTEM 12/2006

8 PLANETS

THE NEW COSMIC ORDER

NATIONAL GEOGRAPHIC

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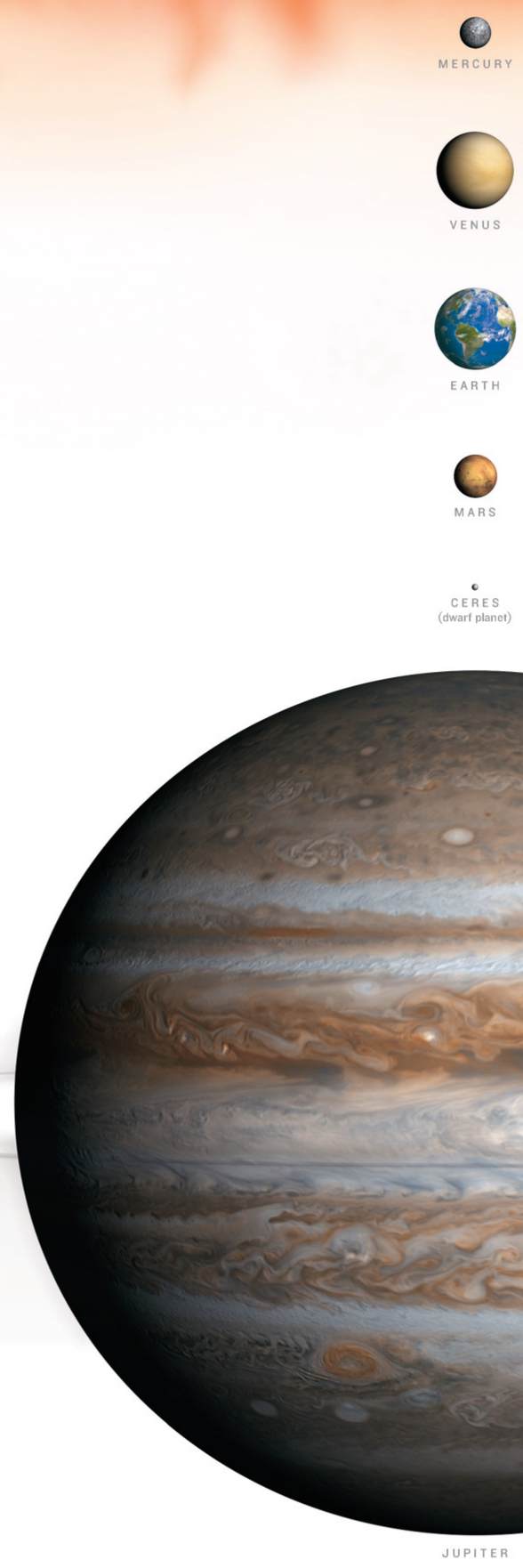
The correct answer to "How many planets are there?" is once again "eight." The solar system's exclusive planetary club has officially returned to the membership it claimed before 1930. That's the year Pluto came aboard as an endearing oddball—so small, so far out. Then in 1992, the discovery that Pluto's immediate neighborhood, a region called the Kuiper belt, held other Pluto-like bodies set off a debate: What is a planet? How many should there be? Nine? Ten? An ever rising number as new findings occur? Last August the International Astronomical Union approved a concise but controversial definition: A planet must orbit the sun; it must not be a satellite; it must be massive enough for its own gravity to keep it round, and also big enough to dominate its orbit. On the last requirement, Pluto falls short—other orbiting bodies also occupy the Kuiper belt. Pluto instead will be loosely classified a "dwarf planet," along with the asteroid Ceres and the recently discovered Kuiper belt body named Eris. Other candidates are pending. Dwarf planets with orbits beyond Neptune will be given a special category, as yet untitled, and Pluto will be honored as the prototype.

Planet sizes to scale; distance not to scale



TERRESTRIAL PLANETS

MERCURY
(Diagram shows angle of planet's rotational axis.)
Average distance from sun 35.9 million miles
Rotation period (day) 58.6 Earth days
Orbital period (year) 87.9 Earth days
Diameter 3,032 miles
Gravity 100 Earth pounds = 38 pounds on Mercury
Only slightly larger than Earth's moon, which its cratered surface resembles, the smallest planet is virtually without an atmosphere and has the most extreme daily temperature swings of any planet, from about 800°F to minus 280°F. Its axis is almost vertical, so polar regions get little to no sun and may hold ice.

VENUS
Average distance from sun 67.2 million miles
Rotation period (day) 243 Earth days
Orbital period (year) 224.7 Earth days
Diameter 7,521 miles
Gravity 100 Earth pounds = 91 pounds on Venus
Though nearly twice as far from the sun as Mercury, Venus is almost 100 degrees hotter. Beneath a cauldron of sulfuric acid clouds, a carbon dioxide atmosphere holds solar energy with scorching efficiency—a greenhouse effect run wild. Massive volcanoes, some perhaps active, tower on its surface.

EARTH
Average distance from sun 93 million miles
Rotation period (day) 23.9 hours
Orbital period (year) 365.2 days
Diameter 7,926 miles
Number of moons 1
Earth is the one spot in the solar system known to support life, and the only place confirmed to be rich in liquid water.

MARS
Average distance from sun 141.6 million miles
Rotation period (day) 24.6 hours
Orbital period (year) 686.9 Earth days
Diameter 4,222 miles
Gravity 100 Earth pounds = 38 pounds on Mars
Number of moons 2
Titanic forces have made Mars a planet of superlatives: The solar system's tallest mountain, a volcano two and a half times the height of Everest; a canyon that would stretch from California to New York; and evidence of cataclysmic floods before liquid water vanished more than three billion years ago.

DWARF PLANET

CERES
Average distance from sun 257 million miles
Rotation period (day) 9.1 hours
Orbital period (year) 4.6 Earth years
Diameter 602 miles
Gravity 100 Earth pounds = 3 pounds on Ceres
Ceres is the largest object in the asteroid belt between Mars and Jupiter. Hailed as a new planet when discovered in 1801, the rock-and-ice orb was demoted when other asteroids were found.

GIANT PLANETS

JUPITER
Average distance from sun 483.7 million miles
Rotation period (day) 9.9 hours
Orbital period (year) 11.9 Earth years
Diameter 88,846 miles
Gravity 100 Earth pounds = 250 pounds on Jupiter
Number of moons 63 (48 named)
A stormy ball of mostly hydrogen and helium, the largest planet looks layered because alternating east and west winds separate zones of varied composition and temperature. Winds in the Great Red Spot hit 400 miles an hour. Jupiter's entourage of moons includes Europa, with a possible watery ocean beneath a mantle of ice, and Io, with active volcanoes. Like the other giant planets, Jupiter formed under conditions that let it collect rings.

SATURN
Average distance from sun 885.9 million miles
Rotation period (day) 10.7 hours
Orbital period (year) 29.5 Earth years
Diameter 74,898 miles
Gravity 100 Earth pounds = 106 pounds on Saturn
Number of moons 56 (35 named)
Saturn's winds may approach a thousand miles an hour at the equator, neck and neck with Neptune's as the fastest in the solar system. Its majestic main rings—reaching 165,000 miles in diameter but averaging only 150 feet thick—may be shattered icy remnants of comets or moons harnessed by the planet's gravity.

URANUS
Average distance from sun 1.8 billion miles
Rotation period (day) 17.2 hours
Orbital period (year) 84 Earth years
Diameter 31,764 miles
Gravity 100 Earth pounds = 86 pounds on Uranus
Number of moons 27
The cast of planets known to ancient astronomers first grew in 1781 when Uranus was discovered by telescope. Methane colors its atmosphere blue. The planet spins on a 98-degree axis, probably knocked sideways by the impact of an Earth-size object. While other planets spin around the sun like tops, Uranus rolls like a ball.

NEPTUNE
Average distance from sun 2.8 billion miles
Rotation period (day) 16.1 hours
Orbital period (year) 164.8 Earth years
Diameter 30,776 miles
Gravity 100 Earth pounds = 110 pounds on Neptune
Number of moons 13 (9 named)
Like all the giant planets except Uranus, Neptune (discovered in 1846) generates more heat than it absorbs from the distant sun. That internal heat creates weather: winds topping 900 miles an hour and storms akin to Jupiter's Great Red Spot.

DWARF PLANETS

PLUTO
Average distance from sun 3.7 billion miles
Rotation period (day) 6.4 Earth days
Orbital period (year) 247.9 Earth years
Diameter 1,430 miles
Gravity 100 Earth pounds = 8 pounds on Pluto
Number of moons 3
A ball of rock and water ice, topped with methane ice, Pluto may have lost its status as the solar system's ninth planet, but it will always be recognized as the first object identified in the Kuiper belt.

ERIS
Average distance from sun 6.4 billion miles
Rotation period (day) Unknown
Orbital period (year) 560 Earth years
Diameter 1,491 miles (plus or minus 62 miles)
Gravity 100 Earth pounds = 9 pounds on Eris
Number of moons 1
Eris, the Greek goddess of discord, seems an appropriate name for the largest known body in the Kuiper belt. Its 2005 discovery spurred astronomers to create for the first time a definition of planethood, and the debate was rancorous. Brighter than Pluto, and slightly bigger, Eris also seems to be rock and water ice with a methane ice covering.

ART: KEES VEENENBOS, BASED ON PLANETARY MAPS BY BJÖRN JÓNSSON; MARIO ROSSI, SPACE-GRAPHICS; AND NASA

* this swab holds 60,000 years of history.

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NATIONAL GEOGRAPHIC

DECEMBER 2006 • VOL. 210 • NO. 6

Sgt. David Bronson looks to his girlfriend, Ashley Ruckle, in the Prosthetic Lab at Walter Reed Army Medical Center in Washington, D.C. Bronson was injured September 9, 2005, while on patrol in Samarra, Iraq. See story on page 68.

JAMES NACHTWEY

Features

COVER Saturn's rings cast shadows on the planet in this view from the Cassini spacecraft. **IMAGE: NASA/JPL/SPACE SCIENCE INSTITUTE**

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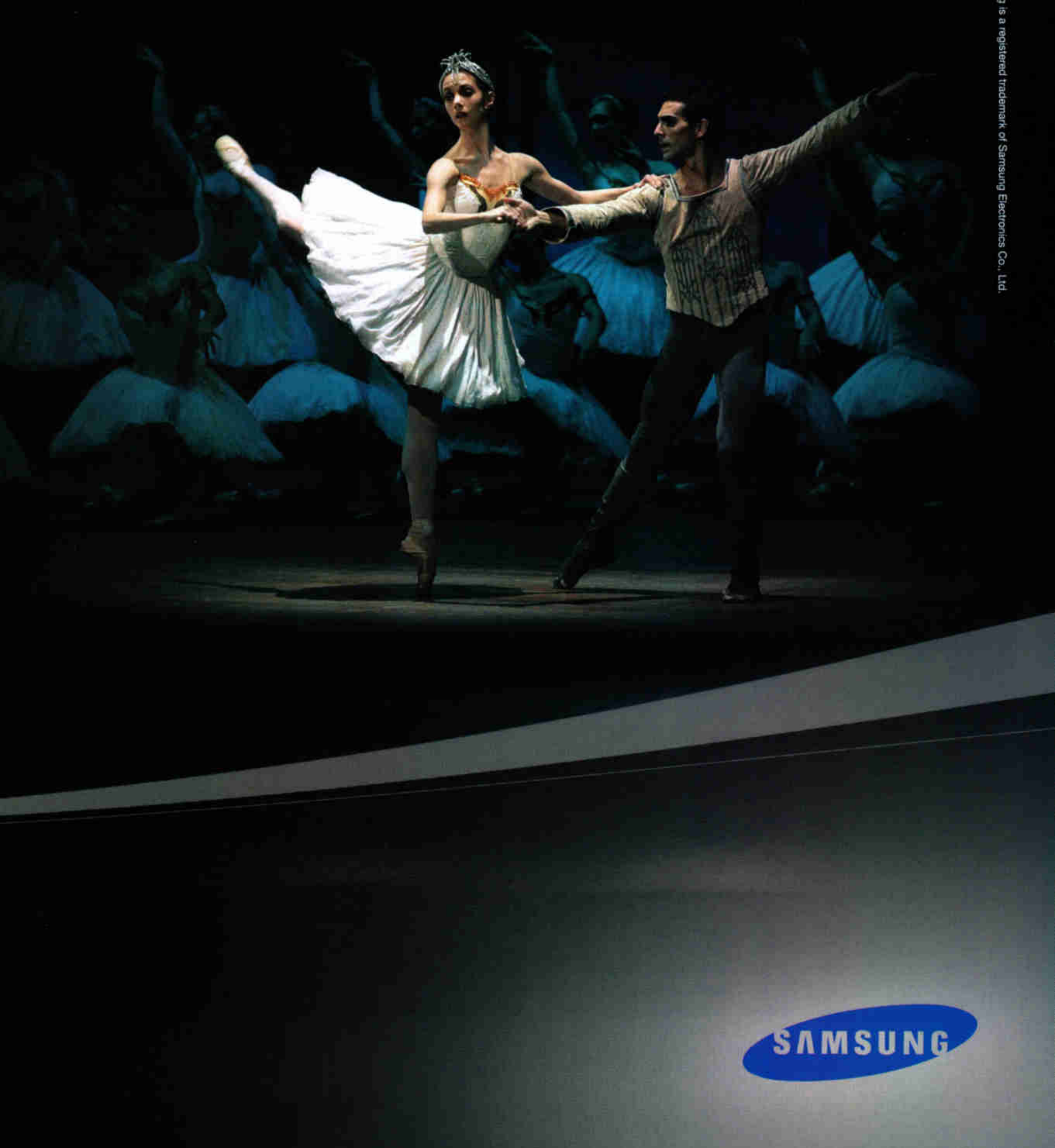

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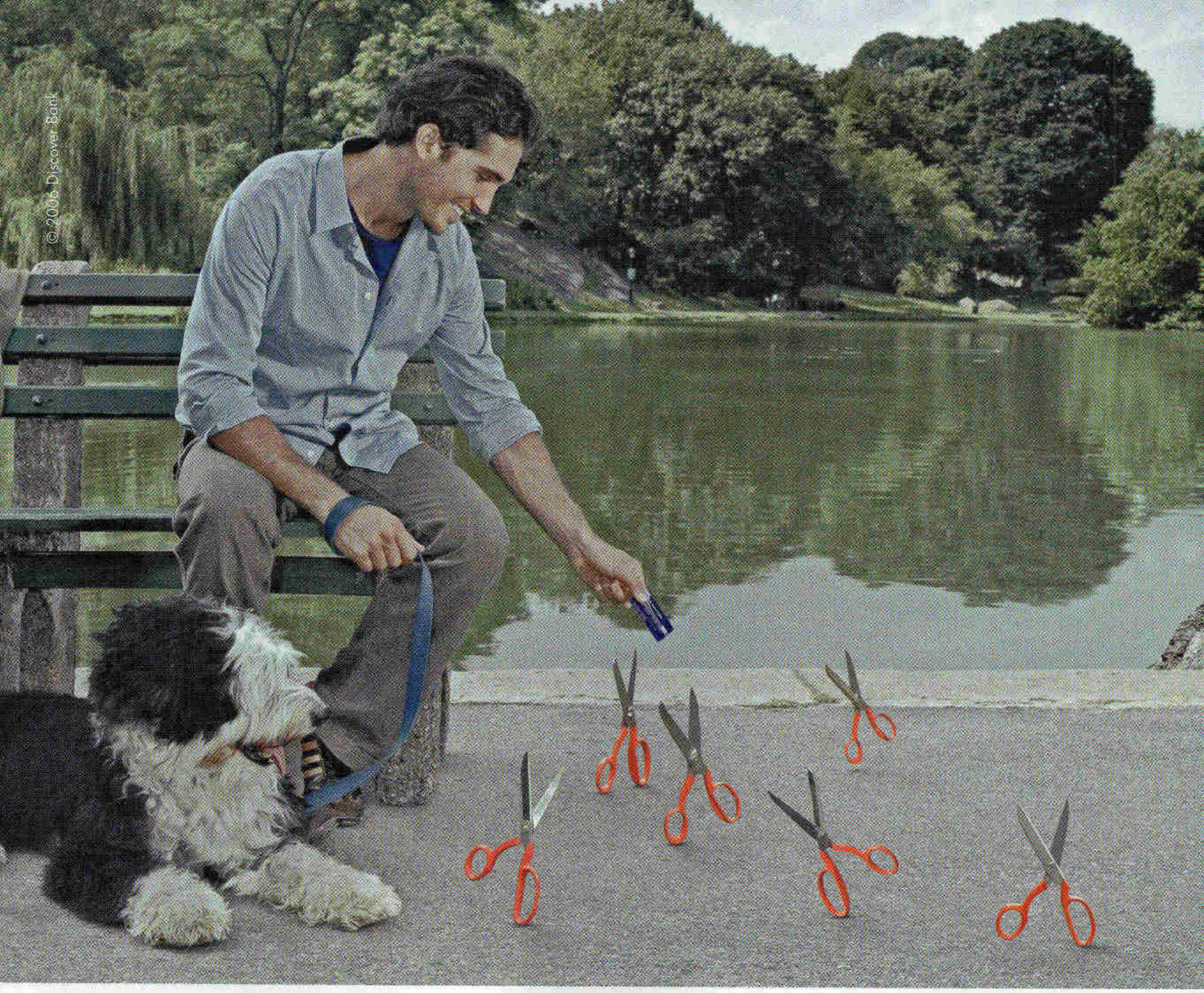

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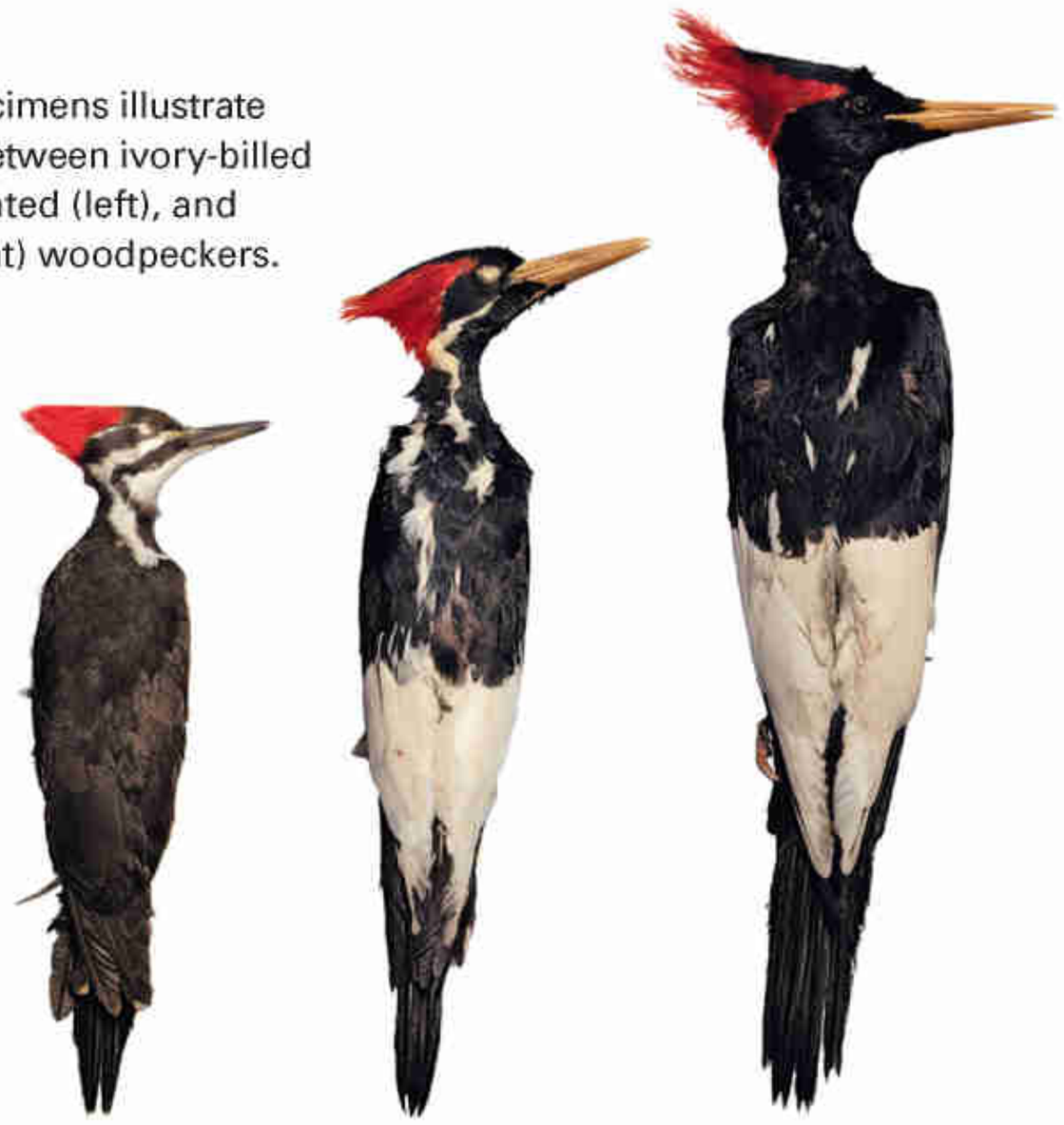

Museum specimens illustrate differences between ivory-billed (center), pileated (left), and imperial (right) woodpeckers.

As I photographed snowy egrets from a stifling hot blind on a mudflat in the Florida Everglades, I suddenly understood why so many people are passionate about birds. The egrets gently dragged their feet across a shallow pool of water—lovely, dance-like behavior meant to attract fish to the surface. I became so absorbed in trying to capture their grace on film, I completely forgot about the heat and buzzing insects. Those magic moments inspired my own pursuit of birds, which would take me from Africa's Zambezi River (where I photographed carmine bee-eaters snatching dragonflies) to Haines, Alaska (where I captured bald eagles feasting on salmon). Now, if I had to choose only one animal to photograph, it would be a bird. And if a higher authority granted me a wish to photograph one rare bird, I'd have to choose the Lord God Bird, the legendary ivory-billed woodpecker.

I'm not alone. Despite the fact that there hasn't been a confirmed U.S. sighting of an ivorybill for 62 years, believers swear the birds are out there. They received new hope with the 2005 announcement that one of the woodpeckers had been spotted flying along a small Arkansas stream. A fuzzy video was offered as part of the evidence. Cornell Laboratory of Ornithology director John Fitzpatrick called it "the conservation story of the century." Other experts soon challenged the claim; the passionate debate rages still.

As Katie Jacques, publisher of a newspaper in Brinkley, Arkansas—self-styled "Home of the Ivory-billed Woodpecker"—told author Mel White: It's about "a faint glimmer of hope of something that's wonderful."

PHOTO: JOEL SARTORE

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IMPORTANT SAFETY INFORMATION: Lunesta works quickly, and should be taken right before bed. Be sure you have at least eight hours to devote to sleep before becoming active. Until you know how you'll react to prescription Lunesta, you should not drive or operate machinery. Do not use alcohol while taking Lunesta. Most sleep medicines carry some risk of dependency. Side effects may include unpleasant taste, headache, drowsiness and dizziness. See important patient information on the next page.

Lunesta™ (eszopiclone)℞

1, 2 AND 3 MG TABLETS

Please read this summary of information about LUNESTA before you talk to your doctor or start using LUNESTA. It is not meant to take the place of your doctor's instructions. If you have any questions about LUNESTA tablets, be sure to ask your doctor or pharmacist.

LUNESTA is used to treat different types of sleep problems, such as difficulty in falling asleep, difficulty in maintaining sleep during the night, and waking up too early in the morning. Most people with insomnia have more than one of these problems. You should take LUNESTA immediately before going to bed because of the risk of falling.

LUNESTA belongs to a group of medicines known as "hypnotics" or, simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Insomnia is often transient and intermittent. It usually requires treatment for only a short time, usually 7 to 10 days up to 2 weeks. If your insomnia does not improve after 7 to 10 days of treatment, see your doctor, because it may be a sign of an underlying condition. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

Side Effects

All medicines have side effects. The most common side effects of sleep medicines are:

- Drowsiness
- Dizziness
- Lightheadedness
- Difficulty with coordination

Sleep medicines can make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of LUNESTA that is best for you. Some people taking LUNESTA have reported next-day sleepiness.

To manage these side effects while you are taking this medicine:

- When you first start taking LUNESTA or any other sleep medicine, until you know whether the medicine will still have some effect on you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- Do not drink alcohol when you are taking LUNESTA or any sleep medicine. Alcohol can increase the side effects of LUNESTA or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking LUNESTA.
- Always take the exact dose of LUNESTA prescribed by your doctor. Never change your dose without talking to your doctor first.

Special Concerns

There are some special problems that may occur while taking sleep medicines.

Memory Problems

Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine. Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia." Memory problems have been reported rarely by patients taking LUNESTA in clinical studies. In most cases, memory problems can be avoided if you take LUNESTA only when you are able to get a full night of sleep before you need to be active again. Be sure to talk to your doctor if you think you are having memory problems.

Tolerance

When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness in helping you sleep. This is known as "tolerance." Development of tolerance to LUNESTA was not observed in a clinical study of 6 months' duration. Insomnia is often transient and intermittent, and prolonged use of sleep medicines is generally not necessary. Some people, though, have chronic sleep problems that may require more prolonged use of sleep medicine. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence

Sleep medicines can cause dependence in some people, especially when these medicines are used regularly for longer than a few weeks or at high doses. Dependence is the need to continue taking a medicine because stopping it is unpleasant. When people develop dependence, stopping the medicine suddenly may cause unpleasant symptoms (see *Withdrawal* below). They may find they have to keep taking the medicine either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks. If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting LUNESTA or any sleep medicine.

Withdrawal

Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two. In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and, rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon. Although withdrawal symptoms have not been observed in the relatively limited controlled trials experience with LUNESTA, there is, nevertheless, the risk of such events in association with the use of any sleep medicine.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking LUNESTA or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes In Behavior And Thinking

Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- More outgoing or aggressive behavior than normal
- Confusion
- Strange behavior
- Agitation
- Hallucinations
- Worsening of depression
- Suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used. Clinical experience with LUNESTA suggests that it is rarely associated with these behavior changes.

It is also important to realize it is rarely clear whether these behavior changes are caused by the medicine, are caused by an illness, or have occurred on their own. In fact, sleep problems that do not

improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

Pregnancy And Breastfeeding

Sleep medicines may cause sedation or other potential effects in the unborn baby when used during the last weeks of pregnancy. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking LUNESTA.

In addition, a very small amount of LUNESTA may be present in breast milk after use of the medication. The effects of very small amounts of LUNESTA on an infant are not known; therefore, as with all other prescription sleep medicines, it is recommended that you not take LUNESTA if you are breastfeeding a baby.

Safe Use Of Sleep Medicines

To ensure the safe and effective use of LUNESTA or any other sleep medicine, you should observe the following cautions:

1. LUNESTA is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take LUNESTA.
2. Never use LUNESTA or any other sleep medicine for longer than directed by your doctor.
3. If you notice any unusual and/or disturbing thoughts or behavior during treatment with LUNESTA or any other sleep medicine, contact your doctor.
4. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription and herbal preparations. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking LUNESTA or any other sleep medicine.
5. Do not take LUNESTA unless you are able to get 8 or more hours of sleep before you must be active again.
6. Do not increase the prescribed dose of LUNESTA or any other sleep medicine unless instructed by your doctor.
7. When you first start taking LUNESTA or any other sleep medicine, until you know whether the medicine will still have some effect on you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
8. Be aware that you may have more sleeping problems the first night or two after stopping any sleep medicine.
9. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, if you become pregnant, or if you are breastfeeding a baby while taking LUNESTA.
10. As with all prescription medicines, never share LUNESTA or any other sleep medicine with anyone else. Always store LUNESTA or any other sleep medicine in the original container and out of reach of children.
11. Be sure to tell your doctor if you suffer from depression.
12. LUNESTA works very quickly. You should only take LUNESTA immediately before going to bed.
13. For LUNESTA to work best, you should not take it with or immediately after a high-fat, heavy meal.
14. Some people, such as older adults (i.e., ages 65 and over) and people with liver disease, should start with the lower dose (1 mg) of LUNESTA. Your doctor may choose to start therapy at 2 mg. In general, adults under age 65 should be treated with 2 or 3 mg.
15. Each tablet is a single dose; do not crush or break the tablet.

Note: This summary provides important information about LUNESTA. If you would like more information, ask your doctor or pharmacist to let you read the Prescribing Information and then discuss it with him or her.

Rx only

SEPRACOR

LETTERS

August 2006 *Bill McKibben's essay, "A Deeper Shade of Green," sparked the most letters this month, a first for Voices. Many wrote in about problems they feel plague the environment, including overpopulation and carbon dioxide emissions. The essay even moved an Oklahoma pastor to ask for copies to give to his community.*

Comment on December stories at **ngm.com.**

Voices: A Deeper Shade of Green

This is the first time I've ever ripped an article straight from the magazine and hand-carried it to someone I thought should read it. Bill McKibben's article should speak volumes to my generation—early 20s, technologically dependent, well educated, yet inexperienced and about to face the greatest challenge ever to confront the human race. It's no longer about not letting the faucet drip or the toilet run or keeping the fan on all day when you're not home. It's about completely rearranging society as we know it.

KELLY ASHE
Utica, New York

The introduction states, "human failings are destroying the planet." Pray tell how this is possible. This planet has been around billions of years; humans, a minuscule, insignificant, entirely inconsequential portion of that. This planet will be here long, long after we humans vanish and are forgotten. Scare pieces such as McKibben's do not serve any useful purpose.

JOHN P. HAMMETT
Midland, Texas

It occurred to me while reading McKibben's article that, personally, I don't want to spend the winter eating locally grown potatoes. It also occurred to me that there is no reason I should have to. All the clean energy we could ever need is there for the taking—wind in the Great Plains, sun in the West, the trash we produce. The question is, will we create our Renaissance now, or will we have to have a Dark Ages first? The decision is ours.

DONALD DODGE
Lafayette, Colorado

Bill McKibben needs to nourish his ideas about cultural environmentalism by getting out of the insularity of his Vermont valley. His experiment with eating locally grown food over a single winter reminds me of Marie Antoinette playing peasant in the hamlet at Versailles. Applying McKibben solutions to Los Angeles County, for example, would have 800 people surviving on each acre of land that produces fruits and vegetables. Suppose that acre be put to potatoes. Each individual would get about 30 calories a day to survive on. Should they need more? Well, let them eat cake!

TOM FERRELL
St. Helena, California

I am a pastor in the Oklahoma Panhandle, and I just finished reading the insightful views of Bill McKibben. Most folks here refuse to believe that global warming is connected to human activity. I believe his thoughts could help make a transition in community and religious thinking.

REVEREND TORREY CURTIS
Beaver United Methodist Church
Beaver, Oklahoma

New Orleans Portfolio

Your article on New Orleans tells only part of the story. It is true that the devastation cannot be overstated; however, the outpouring of compassion and help cannot be overstated either. New Orleans was flooded with polluted water, but it has also been flooded with thousands of people wanting to help, expecting nothing in return. Yes, New Orleans will come back with the help of kind and compassionate people. Their story is one that needs to be told too.

GINGER DOWNIE
Covington, Louisiana

David Burnett's photographs are amazing. They have a toy-like quality. They appear to be pictures of a diorama that one might construct for a model railroad; a diorama

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Write
National Geographic Magazine
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Washington, DC 20090-8199

Email
ngsforum@nationalgeographic.com

Fax
202-828-5460
Include name, address, and daytime telephone. Letters may be edited for clarity and length.

Galapagos Sea Lion *(Zalophus wollebaeki)*
Size: Head and body length, males 200 - 250 cm; females 150 - 200 cm **Weight:** Males 200 - 400 kg; females 50 - 110 kg **Habitat:** Cool, fish-rich waters near the coast; on land it prefers sandy or rocky flat beaches with vegetation for shade **Surviving number:** Estimated at 14,000 - 16,000

Photographed by Tui de Roy

WILDLIFE AS CANON SEES IT

Who's the biggest bully on the beach? In the case of the Galapagos sea lion, each colony has its own top bull - a dominant male who keeps busy pushing, biting and barking at invading bachelors. It's an exhausting role, which helps explain why colony leaders have an average tenure of less than a month. Life is a little less stressful in the water, where the exceptionally powerful diver makes short work of fish, octopi and crustaceans. But there are things to worry about even there, including the devastating effects of El Niño and the chance that the sea lion's inquisitive nature will bring it too close to humans and the potentially fatal dangers that accompany them.

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LETTERS

swept away and destroyed by an angry child. The metaphor is haunting, terrifying.

ROSS ANDERSON
Sutter Creek, California

As a fellow photojournalist, I take my hat off to both David Burnett and NATIONAL GEOGRAPHIC for the Katrina aftermath photographs. I found myself mesmerized by the subjects and the photos. They show a mastery that is rarely displayed in our age of digital manipulation. Thank you for sharing these images with the world.

DAVID HAYES
Anchorage, Alaska

A Geographic Life

After I read the article on Tom Abercrombie, memories rushed like white water. I remember in early 1966 sitting on the floor in my grandfather's studio, the "sacred realm" where he kept his NATIONAL GEOGRAPHICS. The first article I read was about Saudi Arabia. Tom's picture of the whirlpool of pilgrims in Mecca was the reason I became a photographer. I felt enthusiastically connected to Tom's life because, in a way, one of his photographs changed my life.

CARLOS M. MARTINEZ-ESCALONA
Guadalajara, Mexico

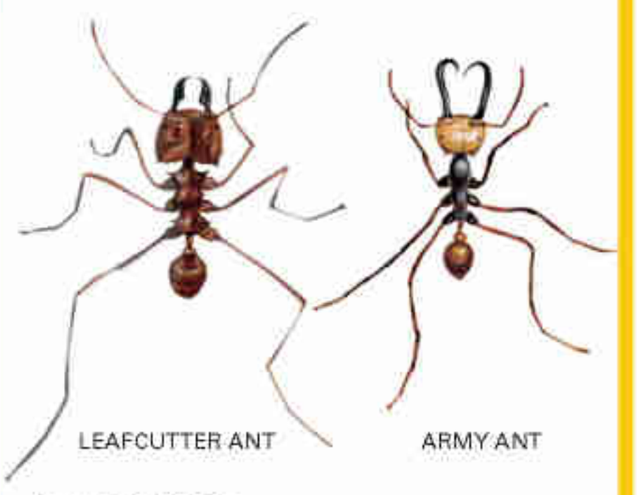
What a man. What a career. The article moved me deeply. I'm sure everyone who knew Tom, in every country he visited, was enriched by his presence. And for those of us longtime subscribers to NGM, he'll certainly be missed, as he brought the mysterious and largely inaccessible areas of the world into our lives.

JEANINE MARTIN
Trinidad, California

Fifty years ago I was asked to be on the lookout for a photographer from NATIONAL GEOGRAPHIC. At the time, I was a staff photographer for the Colonial Williamsburg Foundation, and my boss asked me to help the magazine staffer. Tom Abercrombie and I became fast friends. He certainly knew the often quoted adage that a picture is worth a thousand words, but he also knew that it took words to say that. Don Belt and staff have provided all who were privileged to know this extraordinary man with an excellent look back over the contributions he left us through his work.

CHILES T. A. LARSON
Williamsburg, Virginia

Corrections, Clarifications



August 2006:

Army Ants on the March The cover illustration, taken from the artwork on page 136, incorrectly shows a leafcutter ant, not an army ant.

Super Storms The upper right graph on page 74 of the hurricane article plots all Atlantic hurricanes, not just those in Categories 4 and 5.

A Geographic Life The self-portrait of Tom Abercrombie on page 113 was taken in Medina, not Mecca.

Inside Geographic Writer Ernest Gaines's academic affiliation was misidentified in the August contributors page. He is emeritus writer-in-residence at the University of Louisiana at Lafayette.

Dinner will be served promptly at whatever o'clock.

NCL

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Hot Streak This issue's Your Shot theme of "Heat" had readers sending images of hot stuff from bonfires to beach sand to dogs with lolling tongues. Submit a favorite photograph of your own—on any topic of your choosing—for possible publication in an upcoming issue of NATIONAL GEOGRAPHIC. For guidelines and a submission form, and to see more readers' photography, go to *ngm.com/yourshot.*

Alexzandra Chandler Atlanta, Georgia

The illuminated spire atop Atlanta's Bank of America building takes a sudden hit in this series of video images made by Alexzandra Chandler, 21. Cracks of thunder had kept her from sleeping that night. Just before dawn, she set the camera in her apartment window in hopes of capturing a lightning strike—and got lucky. The theme for this month's Your Shot may have been "Heat," but Chandler says, "That lightning was pretty cool."

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*vs. ordinary alkaline batteries. Results vary by camera.

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TRUSTED EVERYWHERE

Raised arms reflected in icy January waters, a Russian Orthodox priest offers a blessing in Transdniestria.

Jonas Bendiksen spent seven years photographing the former Soviet Union. A collection of his work, *Satellites,* was published by the Aperture Foundation.

Aftermath of History Some of the world's most interesting and poignant stories never show up on the front page. They get tucked into a corner of page 23, if they're told at all. Along the periphery of the old Soviet Union I've found places where the transition to a new world order has been particularly shaky. In eastern Europe, the Caucasus, Central Asia, and eastern Siberia, unrecognized ministates have come into being, communities are frozen in old conflicts, and people are struggling to make lives for themselves largely isolated from the rest of the world.

When you're searching for something faint and faraway, you often can't see it looking straight on. But shift your gaze, and it appears in your peripheral vision. Journalism can work the same way, I think. Sometimes you have to dig into a small, obscure story to say something clear about an issue right in front of you.

I photographed this outdoor ceremony in a sliver of eastern Europe called Transdniestria, where powerful ethnic Russians insist they're running an independent country—though no other nation recognizes the claim. After I'd done a whole collection of such stories about forgotten places in the former Soviet Union, I realized that each was a piece of a bigger puzzle, part of a larger story about the collapse of an empire.

Insider's Look See more of Jonas Bendiksen's photographs in "On the Trail With Nepal's Maoists" at **ngm.com/0511/feature3.**

WELCOME

TO THE

DEPTHS OF THE

OCEANS.

ROLEX

MAKES WALKING ON THE MOON
SEEM PEDESTRIAN.

ROLEX

1992. Theo Mavrostomos broke the deep-diving record under simulated conditions. Using a hydrogen breathing mixture, he reached a record depth of 2,300 feet / 701 meters.

Since 1979, the Rolex Submariner has been waterproof to 1,000 feet / 300 meters. It has remained the quintessential sportsman's watch and standard equipment for divers around the world.

Known as "Her Deepness" or "The Sturgeon General," Dr. Sylvia Earle has logged more than 6,000 hours underwater studying marine ecosystems. At 3,280 feet / 1,000 meters, she also holds the women's depth record for solo diving in a submersible.

Divers who work underwater for long periods of time breathe a mixture of helium, oxygen and hydrogen inside pressurized undersea chambers. As divers ascend, the helium expands inside the watch, putting the watch at risk of exploding. The Rolex Sea-Dweller is not only pressure-proof to 4,000 feet / 1,220 meters, but it has a patented helium escape valve to release it. In 1971, Delauze's underwater engineering company, Comex, required all of its divers to wear one.

Photographer David Doubilet has spent much of his life underwater capturing images of sea life. Many of his photographs document the existence of some species that live in the far corners of our oceans.

1968. Henri-Germain Delauze was the first to complete an experimental dive to 1,099 feet / 335 meters, using a chamber filled with a helium breathing mixture. While performing tasks for long periods of time and at great depths, divers use a chamber as a place to recover without having to go through repeated decompression stages underwater.

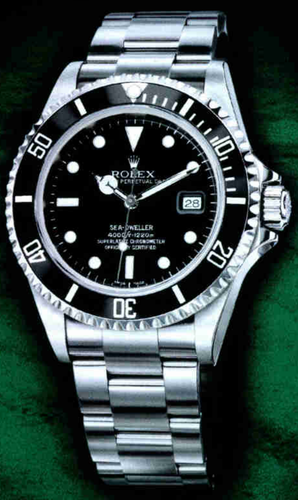
At around 3,280 feet / 1,000 meters, total darkness occurs because sunlight cannot penetrate any deeper. However, the luminescent hands and the indices of the Rolex Sea-Dweller are visible.

1960. Jacques Piccard attached a Rolex prototype, the Deep Sea Special, to the outside of the bathyscaph Trieste. He descended 35,813 feet / 10,916 meters into the deepest parts of the Mariana Trench, subjecting the watch to one ton of pressure per square centimeter. It returned unscathed.

1953. The Rolex Submariner is launched. Specifically designed for divers, and first guaranteed waterproof to 328 feet / 100 meters, it is equipped with a rotatable bezel. Allowing divers to track elapsed time, it has become a key piece of diving equipment.

1926. The Rolex Oyster is born. Its patented waterproof case features a crown that screws into place, closing it as securely as the hatch on a submarine. It's called the "Oyster" for its ability to remain perfectly sealed underwater. Indefinitely.

The oceans are the largest habitat on our planet, covering about 70 percent of the Earth's surface. Yet less than 10 percent has been explored so far.



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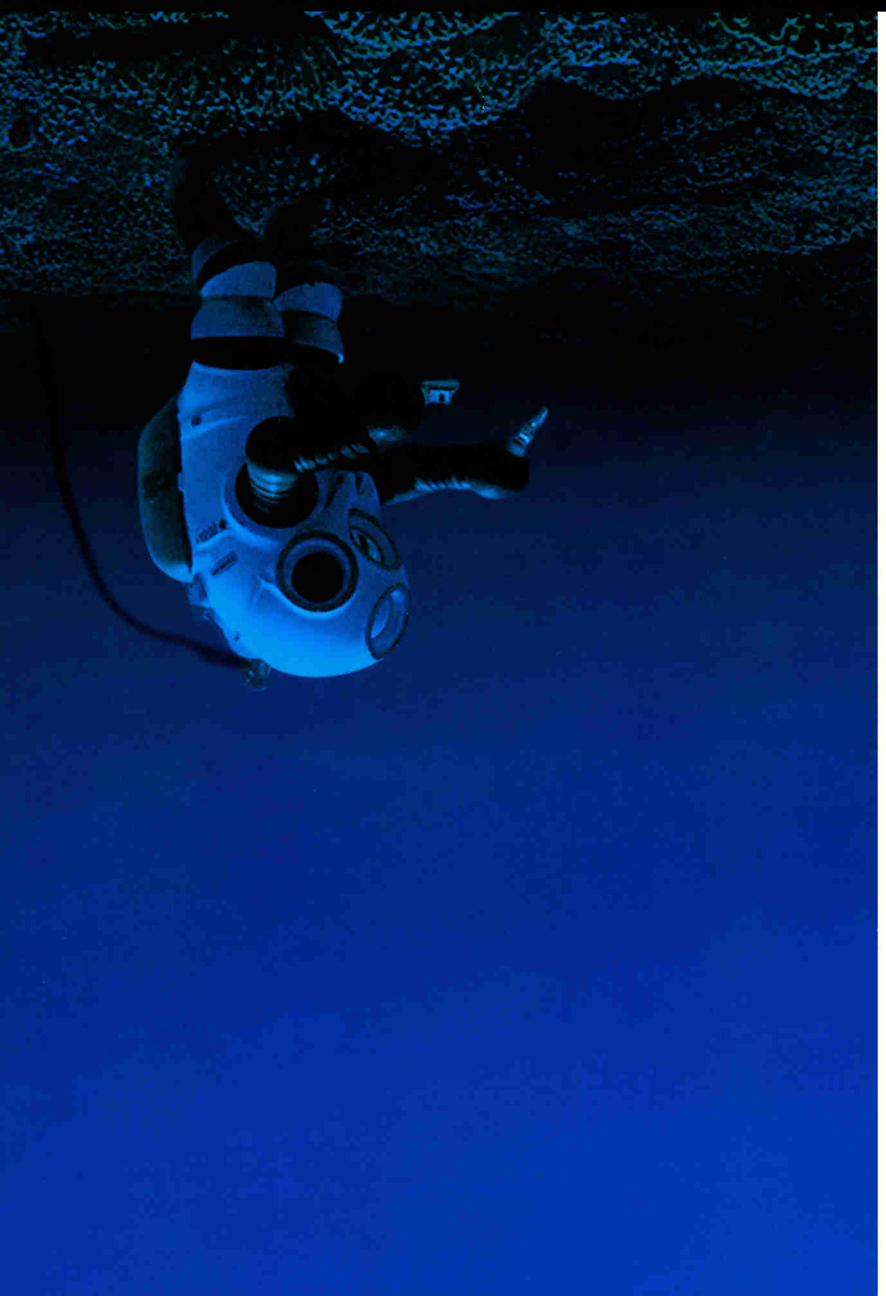
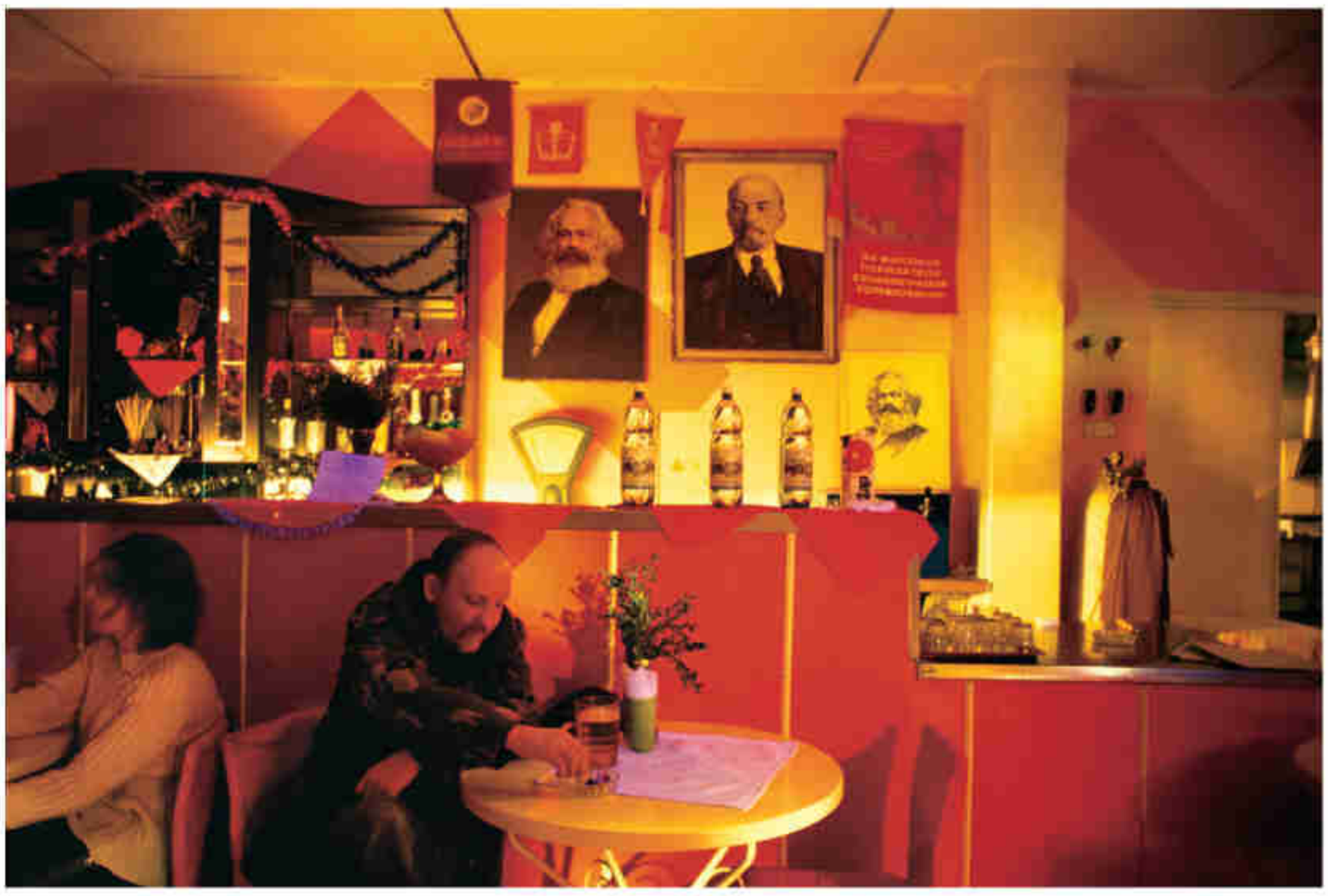


PHOTO JOURNAL | JONAS BENDIKSEN

A handful of beachgoers enjoy warm Black Sea waters edging Abkhazia, a breakaway region of Georgia that was once a luxury resort for favored Soviets; Joseph Stalin kept a house here. Tourism is only starting to rebound after the brutal 1993 civil war that killed thousands and drove tens of thousands of ethnic Georgians from the region.



Soviet heroes Marx and Lenin watch over patrons of Red Heat, a bar in Tiraspol, Transdniestria's largest city. Lodged between the Dniester River and the southwest border of Ukraine, the region fought a civil war with Moldova more than a decade ago and declared itself independent. Transdniestrians cling to the trappings of their communist past and maintain close relations with Moscow.

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HV10

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imageANYWARE

PHOTO JOURNAL | JONAS BENDIKSEN

Before Abkhazia's civil war, this building in the city of Sokhumi housed hundreds of families. When photographer Jonas Bendiksen arrived, an elderly woman named Tanya and her dog (above) were still sheltering in the bombed-out wreck. "What freedom was won?" the weary 80-year-old asked. "Was it worth the price?"

For ten rubles each, tourists visiting the Black Sea resorts of Abkhazia can have a picture taken with this entrepreneur's stuffed bear. Though the region has rejected Georgian control and boasts its own constitution, president, and military, Abkhaz sovereignty has not been recognized by any nation—so Abkhazis must apply for Russian passports to travel outside their borders.

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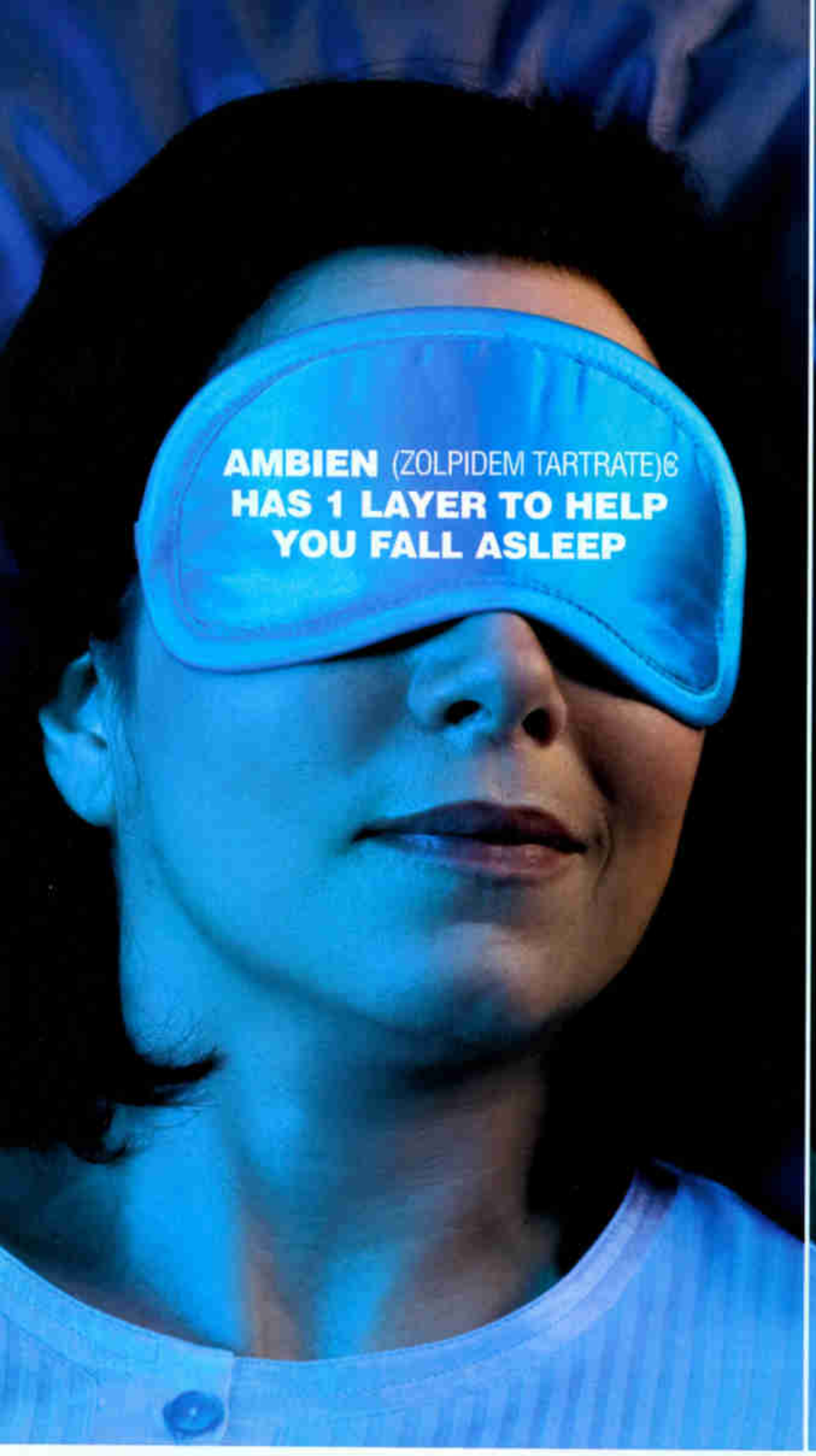
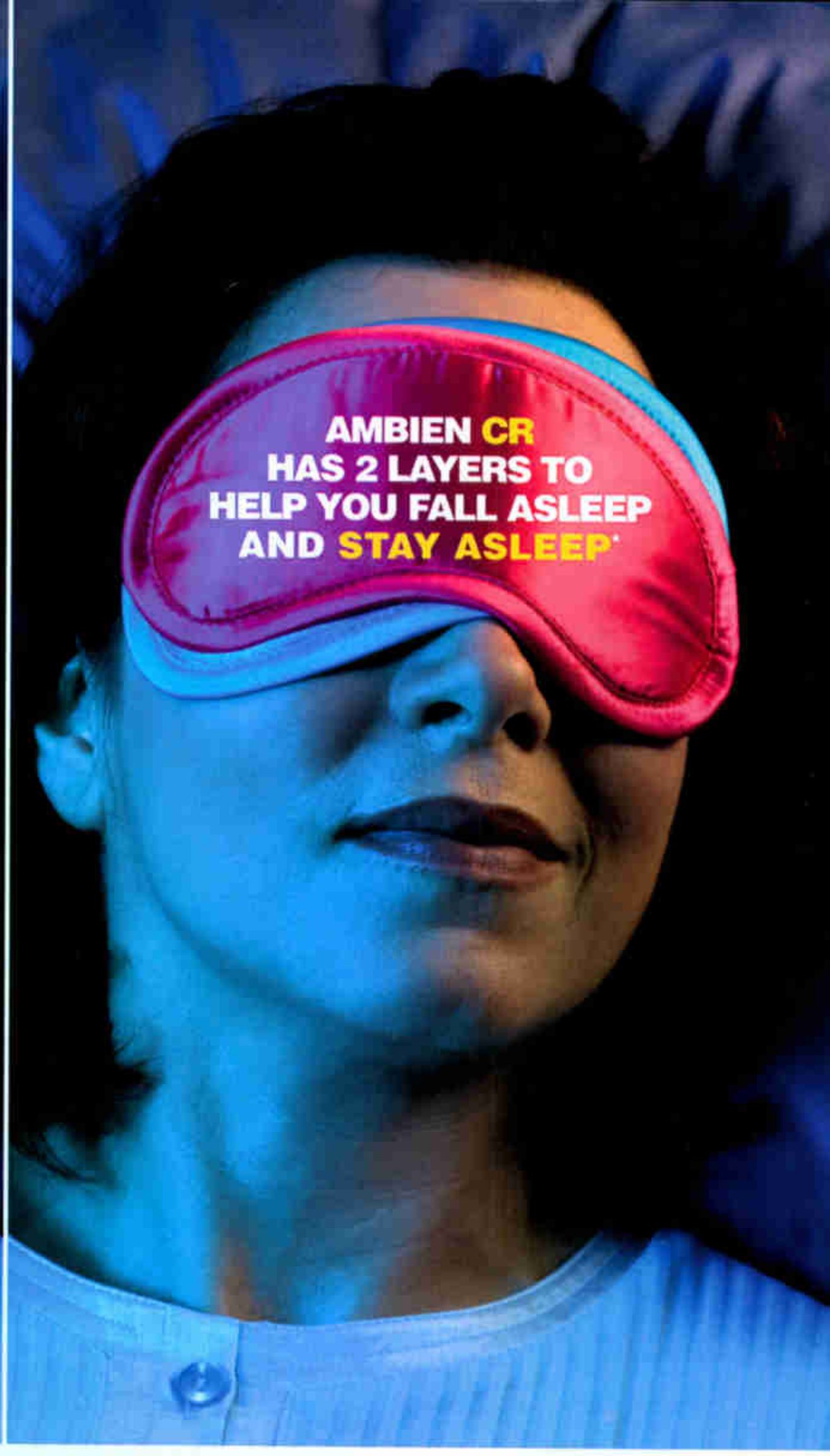
PHOTO JOURNAL | JONAS BENDIKSEN

Villagers in the Altay region of southern Russia—almost a thousand miles downrange from Kazakhstan's mighty Baykonur Cosmodrome—scavenge valuable scrap from booster rockets that tumble to Earth here. Verdant hills and a passing snow squall of butterflies belie the caustic hazards of contact with highly toxic fuel residues.

The Sheriff consortium—backed by the son of Transdniestria's president—owns the Tiraspol stadium (left) and the local soccer team. Vastly wealthy in a region where chronic poverty is as widespread and severe as anywhere in Europe, Sheriff also owns gas stations and supermarkets, operates the mobile phone network, and controls Internet access for Transdniestria's nearly 600,000 residents.





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With AMBIEN CR, getting to sleep fast and staying asleep helps you wake up and get ready for the day.** AMBIEN CR is a treatment option you and your doctor can consider along with lifestyle changes and can be taken for as long as your doctor recommends. Ask your doctor about the latest AMBIEN, AMBIEN CR — and don't forget to mention the CR.

**Proven effective for up to 7 hours in clinical studies.* ***Individual results may vary.*

Important Safety Information

AMBIEN is indicated for the short-term treatment of insomnia.

When you first start taking AMBIEN, use caution in the morning when engaging in activities requiring complete alertness until you know how you will react to this medication. In most instances, memory problems can be avoided if you take AMBIEN only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again. As with any sleep medication, do not use alcohol while you are taking AMBIEN.

Prescription sleep aids are often taken for 7 to 10 days — or longer as advised by your doctor. Like most sleep medicines, it has some risk of dependency.

There is a low occurrence of side effects associated with the short-term use of AMBIEN. The most commonly observed side effects in controlled clinical trials were drowsiness (2%), dizziness (1%), and diarrhea (1%).

AMBIEN CR is indicated for treating insomnia.

It is a treatment option you and your doctor can consider along with lifestyle changes and can be taken for as long as your doctor recommends. Until you know how AMBIEN CR will affect you, you shouldn't drive or operate machinery. Be sure you're able to devote 7 to 8 hours to sleep before being active again. Side effects may include next-day drowsiness, dizziness and headache. It's non-narcotic; however, like most sleep medicines, it has some risk of dependency. Don't take it with alcohol.

sanofi aventis

†Not actual pill size. Please see important patient information on adjoining page. US.ACR.06.08.043 August 2006 Printed in USA

Ambien® CIV

(zolpidem tartrate)

BRIEF SUMMARY

INDICATIONS AND USAGE

Ambien (zolpidem tartrate) is indicated for the short-term treatment of insomnia. Ambien has been shown to decrease sleep latency and increase the duration of sleep for up to 35 days in controlled clinical studies.

Hypnotics should generally be limited to 7 to 10 days of use, and reevaluation of the patient is recommended if they are to be taken for more than 2 to 3 weeks. Ambien should not be prescribed in quantities exceeding a 1-month supply (see *Warnings*).

CONTRAINDICATIONS

None known.

WARNINGS

Since sleep disturbances may be the presenting manifestation of a physical and/or psychiatric disorder, symptomatic treatment of insomnia should be initiated only after a careful evaluation of the patient. The failure of insomnia to remit after 7 to 10 days of treatment may indicate the presence of a primary psychiatric and/or medical illness which should be evaluated. Worsening of insomnia or the emergence of new thinking or behavior abnormalities may be the consequence of an unrecognized psychiatric or physical disorder. Such findings have emerged during the course of treatment with sedative/hypnotic drugs, including Ambien. Because some of the important adverse effects of Ambien appear to be dose related (see *Precautions* and *Dosage and Administration*), it is important to use the smallest possible effective dose, especially in the elderly.

A variety of abnormal thinking and behavior changes have been reported to occur in association with the use of sedative/hypnotics. Some of these changes may be characterized by decreased inhibition (eg, aggressiveness and extroversion that seemed out of character), similar to effects produced by alcohol and other CNS depressants. Other reported behavioral changes have included bizarre behavior, agitation, hallucinations, and depersonalization. Amnesia and other neuropsychiatric symptoms may occur unpredictably. In primarily depressed patients, worsening of depression, including suicidal thinking, has been reported in association with the use of sedative/hypnotics.

It can rarely be determined with certainty whether a particular instance of the abnormal behaviors listed above is drug induced, spontaneous in origin, or a result of an underlying psychiatric or physical disorder. Nonetheless, the emergence of any new behavioral sign or symptom of concern requires careful and immediate evaluation.

Following the rapid dose decrease or abrupt discontinuation of sedative/hypnotics, there have been reports of signs and symptoms similar to those associated with withdrawal from other CNS-depressant drugs (see *Drug Abuse and Dependence*).

Ambien, like other sedative/hypnotic drugs, has CNS-depressant effects. Due to the rapid onset of action, Ambien should only be ingested immediately prior to going to bed. Patients should be cautioned against engaging in hazardous occupations requiring complete mental alertness or motor coordination such as operating machinery or driving a motor vehicle after ingesting the drug, including potential impairment of the performance of such activities that may occur the day following ingestion of Ambien. Ambien showed additive effects when combined with alcohol and should not be taken with alcohol. Patients should also be cautioned about possible combined effects with other CNS-depressant drugs. Dosage adjustments may be necessary when Ambien is administered with such agents because of the potentially additive effects.

PRECAUTIONS

General

Use in the elderly and/or debilitated patients: Impaired motor and/or cognitive performance after repeated exposure or unusual sensitivity to sedative/hypnotic drugs is a concern in the treatment of elderly and/or debilitated patients. Therefore, the recommended Ambien dosage is 5 mg in such patients (see *Dosage and Administration*) to decrease the possibility of side effects. These patients should be closely monitored.

Use in patients with concomitant illness: Clinical experience with Ambien in patients with concomitant systemic illness is limited. Caution is advisable in using Ambien in patients with diseases or conditions that could affect metabolism or hemodynamic responses. Although studies did not reveal respiratory depressant effects at hypnotic doses of Ambien in normals or in patients with mild to moderate chronic obstructive pulmonary disease (COPD), a reduction in the Total Arousal Index together with a reduction in lowest oxygen saturation and increase in the times of oxygen desaturation below 80% and 90% was observed in patients with mild-to-moderate sleep apnea when treated with Ambien (10 mg) when compared to placebo. However, precautions should be observed if Ambien is prescribed to patients with compromised respiratory function, since sedative/hypnotics have the capacity to depress respiratory drive. Post-marketing reports of respiratory insufficiency, most of which involved patients with pre-existing respiratory impairment, have been received. Data in end-stage renal failure patients repeatedly treated with Ambien did not demonstrate drug accumulation or alterations in pharmacokinetic parameters. No dosage adjustment in renally impaired patients is required; however, these patients should be closely monitored (see *Pharmacokinetics*). A study in subjects with hepatic impairment did reveal prolonged elimination in this group; therefore, treatment should be initiated with 5 mg in patients with hepatic compromise, and they should be closely monitored.

Use in depression: As with other sedative/hypnotic drugs, Ambien should be administered with caution to patients exhibiting signs or symptoms of depression. Suicidal tendencies may be present in such patients and protective measures may be required. Intentional overdosage is more common in this group of patients; therefore, the least amount of drug that is feasible should be prescribed for the patient at any one time.

Information for patients: Patient information is printed in the complete prescribing information.

Laboratory tests: There are no specific laboratory tests recommended.

Drug interactions

CNS-active drugs: Ambien was evaluated in healthy volunteers in single-dose interaction studies for several CNS drugs. A study involving haloperidol and zolpidem revealed no effect of haloperidol on the pharmacokinetics or pharmacodynamics of zolpidem. Imipramine in combination with zolpidem produced no pharmacokinetic interaction other than a 20% decrease in peak levels of imipramine, but there was an additive effect of decreased alertness. Similarly, chlorpromazine in combination with zolpidem produced no pharmacokinetic interaction, but there was an additive effect of decreased alertness and psychomotor performance. The lack of a drug interaction following single-dose administration does not predict a lack following chronic administration.

An additive effect on psychomotor performance between alcohol and zolpidem was demonstrated.

A single-dose interaction study with zolpidem 10 mg and fluoxetine 20 mg at steady-state levels in male volunteers did not demonstrate any clinically significant pharmacokinetic or pharmacodynamic interactions. When multiple doses of zolpidem and fluoxetine at steady-state concentrations were evaluated in healthy females, the only significant change was a 17% increase in the zolpidem half-life. There was no evidence of an additive effect in psychomotor performance.

Following five consecutive nightly doses of zolpidem 10 mg in the presence of sertraline 50 mg (17 consecutive daily doses, at 7:00 am, in healthy female volunteers), zolpidem C_{max} was significantly higher (43%) and T_{max} was significantly decreased (53%). Pharmacokinetics of sertraline and N-desmethylsertraline were unaffected by zolpidem.

Since the systematic evaluations of Ambien in combination with other CNS-active drugs have been limited, careful consideration should be given to the pharmacology of any CNS-active drug to be used with zolpidem. Any drug with CNS-depressant effects could potentially enhance the CNS-depressant effects of zolpidem.

Drugs that affect drug metabolism via cytochrome P450: A randomized, double-blind, crossover interaction study in ten healthy volunteers between itraconazole (200 mg once daily for 4 days) and a single dose of zolpidem (10 mg) given 5 hours after the last dose of itraconazole resulted in a 34% increase in $AUC_{0\rightarrow\infty}$ of zolpidem. There were no significant pharmacodynamic effects of zolpidem on subjective drowsiness, postural sway, or psychomotor performance.

A randomized, placebo-controlled, crossover interaction study in eight healthy female volunteers between 5 consecutive daily doses of rifampin (600 mg) and a single dose of zolpidem (20 mg) given 17 hours after the last dose of rifampin showed significant reductions of the AUC (–73%), C_{max} (–58%), and $T_{1/2}$ (–36%) of zolpidem together with significant reductions in the pharmacodynamic effects of zolpidem.

Other drugs: A study involving cimetidine/zolpidem and ranitidine/zolpidem combinations revealed no effect of either drug on the pharmacokinetics or pharmacodynamics of zolpidem. Zolpidem had no effect on digoxin kinetics and did not affect prothrombin time when given with warfarin in normal subjects. Zolpidem's sedative/hypnotic effect was reversed by flumazenil; however, no significant alterations in zolpidem pharmacokinetics were found.

Drug/Laboratory test interactions: Zolpidem is not known to interfere with commonly employed clinical laboratory tests. In addition, clinical data indicate that zolpidem does not cross-react with benzodiazepines, opiates, barbiturates, cocaine, cannabinoids, or amphetamines in two standard urine drug screens.

Carcinogenesis, mutagenesis, impairment of fertility

Carcinogenesis: Zolpidem was administered to rats and mice for 2 years at dietary dosages of 4, 18, and 80 mg/kg/day. In mice, these doses are 26 to 520 times or 2 to 35 times the maximum 10-mg human dose on a mg/kg or mg/m^2 basis, respectively. In rats these doses are 43 to 876 times or 6 to 115 times the maximum 10-mg human dose on a mg/kg or mg/m^2 basis, respectively. No evidence of carcinogenic potential was observed in mice. Renal liposarcomas were seen in 4/100 rats (3 males, 1 female) receiving 80 mg/kg/day and a renal lipoma was observed in one male rat at the 18 mg/kg/day dose. Incidence rates of lipoma and liposarcoma for zolpidem were comparable to those seen in historical controls and the tumor findings are thought to be a spontaneous occurrence.

Mutagenesis: Zolpidem did not have mutagenic activity in several tests including the Ames test, genotoxicity in mouse lymphoma cells in vitro, chromosomal aberrations in cultured human lymphocytes, unscheduled DNA synthesis in rat hepatocytes in vitro, and the micronucleus test in mice.

Impairment of fertility: In a rat reproduction study, the high dose (100 mg base/kg) of zolpidem resulted in irregular estrus cycles and prolonged precoital intervals, but there was no effect on male or female fertility after daily oral doses of 4 to 100 mg base/kg or 5 to 130 times the recommended human dose in mg/m^2. No effects on any other fertility parameters were noted.

Pregnancy

Teratogenic effects: Category B. Studies to assess the effects of zolpidem on human reproduction and development have not been conducted.

Teratology studies were conducted in rats and rabbits.

In rats, adverse maternal and fetal effects occurred at 20 and 100 mg base/kg and included dose-related maternal lethargy and ataxia and a dose-related trend to incomplete ossification of fetal skull bones.

In rabbits, dose-related maternal sedation and decreased weight gain occurred at all doses tested. At the high dose, 16 mg base/kg, there was an increase in postimplantation fetal loss and underossification of sternebrae in viable fetuses.

This drug should be used during pregnancy only if clearly needed.

Nonteratogenic effects: Studies to assess the effects on children whose mothers took zolpidem during pregnancy have not been conducted. However, children born of mothers taking sedative/hypnotic drugs may be at some risk for withdrawal symptoms from the drug during the postnatal period. In addition, neonatal flaccidity has been reported in infants born of mothers who received sedative/hypnotic drugs during pregnancy.

Labor and delivery: Ambien has no established use in labor and delivery.

Nursing mothers: Studies in lactating mothers indicate that between 0.004 and 0.019% of the total administered dose is excreted into milk, but the effect of zolpidem on the infant is unknown.

The use of Ambien in nursing mothers is not recommended.

Pediatric use: Safety and effectiveness in pediatric patients below the age of 18 have not been established.

Geriatric use: A total of 154 patients in U.S. controlled clinical trials and 897 patients in non-U.S. clinical trials who received zolpidem were ≥60 years of age. For a pool of U.S. patients receiving zolpidem at doses of ≤10 mg or placebo, there were three adverse events occurring at an incidence of at least 3% for zolpidem and for which the zolpidem incidence was at least twice the placebo incidence (ie, they could be considered drug related).

Adverse Event	Zolpidem	Placebo
Dizziness	3%	0%
Drowsiness	5%	2%
Diarrhea	3%	1%

A total of 30/1,959 (1.5%) non-U.S. patients receiving zolpidem reported falls, including 28/30 (93%) who were ≥70 years of age. Of these 28 patients, 23 (82%) were receiving zolpidem doses >10 mg. A total of 24/1,959 (1.2%) non-U.S. patients receiving zolpidem reported confusion, including 18/24 (75%) who were ≥70 years of age. Of these 18 patients, 14 (78%) were receiving zolpidem doses >10 mg.

ADVERSE REACTIONS

Associated with discontinuation of treatment: Approximately 4% of 1,701 patients who received zolpidem at all doses (1.25 to 90 mg) in U.S. premarketing clinical trials discontinued treatment because of an adverse clinical event. Events most commonly associated with discontinuation from U.S. trials were daytime drowsiness (0.5%), dizziness (0.4%), headache (0.5%), nausea (0.6%), and vomiting (0.5%).

Approximately 4% of 1,959 patients who received zolpidem at all doses (1 to 50 mg) in similar foreign trials discontinued treatment because of an adverse event. Events most commonly associated with discontinuation from these trials were daytime drowsiness (1.1%), dizziness/vertigo (0.8%), amnesia (0.5%), nausea (0.5%), headache (0.4%), and falls (0.4%).

Data from a clinical study in which selective serotonin reuptake inhibitor-(SSRI) treated patients were given zolpidem revealed that four of the seven discontinuations during double-blind treatment with zolpidem (n=95) were associated with impaired concentration, continuing or aggravated depression, and manic reaction; one patient treated with placebo (n=97) was discontinued after an attempted suicide.

Incidence in controlled clinical trials

Most commonly observed adverse events in controlled trials: During short-term treatment (up to 10 nights) with Ambien at doses up to 10 mg, the most commonly observed adverse events associated with the use of zolpidem and seen at statistically significant differences from placebo-treated patients were drowsiness (reported by 2% of zolpidem patients), dizziness (1%), and diarrhea (1%). During longer-term treatment (28 to 35 nights) with zolpidem at doses up to 10 mg, the most commonly observed adverse events associated with the use of zolpidem and seen at statistically significant differences from placebo-treated patients were dizziness (5%) and drugged feelings (3%).

Treatment-emergent adverse experiences in placebo-controlled clinical trials: The following are treatment-emergent adverse events from U.S. placebo-controlled clinical trials. Data are limited to data from doses up to and including 10 mg. In short-term trials, events seen in zolpidem patients (n=685) at an incidence equal to 1% or greater compared to placebo (n=473) were: headache (7% vs 6% for placebo), drowsiness (2% vs 0%), dizziness (1% vs 0%), nausea (2% vs 3%), diarrhea (1% vs 0%), and myalgia (1% vs 2%). In long-term clinical trials, events seen in zolpidem patients (n=152) at an incidence of 1% or greater compared to placebo (n=161) were: dry mouth (3% vs 1% for placebo), allergy (4% vs 1%), back pain (3% vs 2%), influenza-like symptoms (2% vs 0%) , chest pain (1% vs 0%), fatigue (1% vs 2%), palpitation (2% vs 0%), headache (19% vs 22%), drowsiness (8% vs 5%), dizziness (5% vs 1%), lethargy (3% vs 1%), drugged feeling (3% vs 0%), lightheadedness (2% vs 1%), depression (2% vs 1%), abnormal dreams (1% vs 0%), amnesia (1% vs 0%), anxiety (1% vs 1%), nervousness (1% vs 3%), sleep disorder (1% vs 0%), nausea (6% vs 6%), dyspepsia (5% vs 6%), diarrhea (3% vs 2%), abdominal pain (2% vs 2%), constipation (2% vs 1%), anorexia (1% vs 1%), vomiting (1% vs 1%), infection (1% vs 1%), myalgia (7% vs 7%), arthralgia (4% vs 4%), upper respiratory infection (5% vs 6%), sinusitis (4% vs 2%), pharyngitis (3% vs 1%), rhinitis (1% vs 3%), rash (2% vs 1%), and urinary tract infection (2% vs 2%).

Dose relationship for adverse events: There is evidence from dose comparison trials suggesting a dose relationship for many of the adverse events associated with zolpidem use, particularly for certain CNS and gastrointestinal adverse events.

Adverse events are further classified and enumerated in order of decreasing frequency using the following definitions: frequent adverse events are defined as those occurring in greater than 1/100 subjects; infrequent adverse events are those occurring in 1/100 to 1/1,000 patients; rare events are those occurring in less than 1/1,000 patients.

Frequent: abdominal pain, abnormal dreams, allergy, amnesia, anorexia, anxiety, arthralgia, asthenia, ataxia, back pain, chest pain, confusion, constipation, depression, diarrhea, diplopia, dizziness, drowsiness, drugged feeling, dry mouth, dyspepsia, euphoria, fatigue, headache, hiccup, infection, influenza-like symptoms, insomnia, lethargy, lightheadedness, myalgia, nausea, nervousness, palpitation, sleep disorder, vertigo, vision abnormal, vomiting.

Infrequent: abnormal hepatic function, agitation, arthritis, bronchitis, cerebrovascular disorder, coughing, cystitis, decreased cognition, detached, difficulty concentrating, dysarthria, dysphagia, dyspnea, edema, emotional lability, eye irritation, eye pain, falling, fever, flatulence, gastroenteritis, hallucination, hyperglycemia, hypertension, hypoesthesia, illusion, increased SGPT, increased sweating, leg cramps, malaise, menstrual disorder, migraine, pallor, paresthesia, postural hypotension, pruritus, scleritis, sleeping (after daytime dosing), speech disorder, stupor, syncope, tachycardia, taste perversion, thirst, tinnitus, trauma, tremor, urinary incontinence, vaginitis.

Rare: abdominal body sensation, abnormal accommodation, abnormal gait, abnormal thinking, abscess, acne, acute renal failure, aggressive reaction, allergic reaction, allergy aggravated, altered saliva, anaphylactic shock, anemia, angina pectoris, apathy, appetite increased, arrhythmia, arteritis, arthrosis, bilirubinemia, breast fibroadenosis, breast neoplasm, breast pain, bronchospasm, bullous eruption, circulatory failure, conjunctivitis, corneal ulceration, decreased libido, delusion, dementia, depersonalization, dermatitis, dysphasia, dysuria, enteritis, epistaxis, eructation, esophagospasm, extrasystoles, face edema, feeling strange, flushing, furunculosis, gastritis, glaucoma, gout, hemorrhoids, herpes simplex, herpes zoster, hot flashes, hypercholesteremia, hyperhemoglobinemia, hyperlipidemia, hypertension aggravated, hypokinesia, hypotension, hypotonia, hypoxia, hysteria, impotence, increased alkaline phosphatase, increased BUN, increased ESR, increased saliva, increased SGOT, injection-site inflammation, intestinal obstruction, intoxicated feeling, lacrimation abnormal, laryngitis, leukopenia, lymphadenopathy, macrocytic anemia, manic reaction, micturition frequency, muscle weakness, myocardial infarction, neuralgia, neuritis, neuropathy, neurosis, nocturia, otitis externa, otitis media, pain, panic attacks, paresis, parosmia, periorbital edema, personality disorder, phlebitis, photopsia, photosensitivity reaction, pneumonia, polyuria, pulmonary edema, pulmonary embolism, purpura, pyelonephritis, rectal hemorrhage, renal pain, restless legs, rigors, sciatica, somnambulism, suicide attempts, tendinitis, tenesmus, tetany, thrombosis, tolerance increased, tooth caries, urinary retention, urticaria, varicose veins, ventricular tachycardia, weight decrease, yawning.

DRUG ABUSE AND DEPENDENCE

Controlled substance: Schedule IV.

Abuse and dependence: Studies of abuse potential in former drug abusers found that the effects of single doses of zolpidem tartrate 40 mg were similar, but not identical, to diazepam 20 mg, while zolpidem tartrate 10 mg was difficult to distinguish from placebo.

Sedative/hypnotics have produced withdrawal signs and symptoms following abrupt discontinuation. These reported symptoms range from mild dysphoria and insomnia to a withdrawal syndrome that may include abdominal and muscle cramps, vomiting, sweating, tremors, and convulsions. The U.S. clinical trial experience from zolpidem does not reveal any clear evidence for withdrawal syndrome. Nevertheless, the following adverse events included in DSM-III-R criteria for uncomplicated sedative/hypnotic withdrawal were reported at an incidence of ≤1% during U.S. clinical trials following placebo substitution occurring within 48 hours following last zolpidem treatment: fatigue, nausea, flushing, lightheadedness, uncontrolled crying, emesis, stomach cramps, panic attack, nervousness, and abdominal discomfort. Rare post-marketing reports of abuse, dependence and withdrawal have been received.

Individuals with a history of addiction to, or abuse of, drugs or alcohol are at increased risk of habituation and dependence; they should be under careful surveillance when receiving any hypnotic.

OVERDOSAGE

Signs and symptoms: In European postmarketing reports of overdose with zolpidem alone, impairment of consciousness has ranged from somnolence to light coma, with one case each of cardiovascular and respiratory compromise. Individuals have fully recovered from zolpidem tartrate overdoses up to 400 mg (40 times the maximum recommended dose). Overdose cases involving multiple CNS-depressant agents, including zolpidem, have resulted in more severe symptomatology, including fatal outcomes.

Recommended treatment: General symptomatic and supportive measures should be used along with immediate gastric lavage where appropriate. Intravenous fluids should be administered as needed. Flumazenil may be useful. Respiration, pulse, blood pressure, and other appropriate signs should be monitored and general supportive measures employed. Sedating drugs should be withheld following zolpidem overdosage. Zolpidem is not dialyzable.

The possibility of multiple drug ingestion should be considered.

Rx only

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INFORMATION FOR PATIENTS
mbien CR™ ®
(zolpidem tartrate extended-release) tablets

AMBIEN CR™
[ZOLPIDEM TARTRATE EXTENDED RELEASE] ®
6.25-MG & 12.5-MG EXTENDED RELEASE TABLETS

INFORMATION FOR PATIENTS TAKING AMBIEN CR

Your doctor has prescribed Ambien CR to help you sleep. The following information is intended to guide you in the safe use of this medicine. It is not meant to take the place of your doctor's instructions. If you have any questions about Ambien CR tablets be sure to ask your doctor or pharmacist.

Ambien CR is used to treat different types of sleep problems, such as:

- trouble falling asleep
- waking up often during the night

Some people may have more than one of these problems.

Ambien CR belongs to a group of medicines known as the "sedative/hypnotics", or simply, sleep medicines. There are many different sleep medicines available to help people sleep better. Sleep problems are usually temporary, requiring treatment for only a short time, usually 1 or 2 days up to 1 or 2 weeks. Some people have chronic sleep problems that may require more prolonged use of sleep medicine. However, you should not use these medicines for long periods without talking with your doctor about the risks and benefits of prolonged use.

SIDE EFFECTS

Most common side effects:

- headache
- somnolence (sleepiness)
- dizziness

You may find that these medicines make you sleepy during the day. How drowsy you feel depends upon how your body reacts to the medicine, which sleep medicine you are taking, and how large a dose your doctor has prescribed. Daytime drowsiness is best avoided by taking the lowest dose possible that will still help you sleep at night. Your doctor will work with you to find the dose of Ambien CR that is best for you.

To manage these side effects while you are taking this medicine:

- When you first start taking Ambien CR or any other sleep medicine until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
- NEVER drink alcohol while you are being treated with Ambien CR or any sleep medicine. Alcohol can increase the side effects of Ambien CR or any other sleep medicine.
- Do not take any other medicines without asking your doctor first. This includes medicines you can buy without a prescription. Some medicines can cause drowsiness and are best avoided while taking Ambien CR.
- Always take the exact dose of Ambien CR prescribed by your doctor. Never change your dose without talking to your doctor first.

SPECIAL CONCERNS

There are some special problems that may occur while taking sleep medicines.

Memory problems: Sleep medicines may cause a special type of memory loss or "amnesia." When this occurs, a person may not remember what has happened for several hours after taking the medicine. This is usually not a problem since most people fall asleep after taking the medicine.

Memory loss can be a problem, however, when sleep medicines are taken while traveling, such as during an airplane flight and the person wakes up before the effect of the medicine is gone. This has been called "traveler's amnesia."

Be sure to talk to your doctor if you think you are having memory problems. Although memory problems are not very common while taking Ambien CR, in most instances, they can be avoided if you take Ambien CR only when you are able to get a full night's sleep (7 to 8 hours) before you need to be active again.

Tolerance: When sleep medicines are used every night for more than a few weeks, they may lose their effectiveness to help you sleep. This is known as "tolerance". Sleep medicines should, in most cases, be used only for short periods of time, such as 1 or 2 days and generally no longer than 1 or 2 weeks. If your sleep problems continue, consult your doctor, who will determine whether other measures are needed to overcome your sleep problems.

Dependence: Sleep medicines can cause dependence, especially when these medicines are used regularly for longer than a few weeks or at high doses. Some people develop a need to continue taking their medicines. This is known as dependence or "addiction."

When people develop dependence, they may have difficulty stopping the sleep medicine. If the medicine is suddenly stopped, the body is not able to function normally and unpleasant symptoms may occur (see *Withdrawal*). They may find that they have to keep taking the medicines either at the prescribed dose or at increasing doses just to avoid withdrawal symptoms.

All people taking sleep medicines have some risk of becoming dependent on the medicine. However, people who have been dependent on alcohol or other drugs in the past may have a higher chance of becoming addicted to sleep medicines. This possibility must be considered before using these medicines for more than a few weeks.

If you have been addicted to alcohol or drugs in the past, it is important to tell your doctor before starting Ambien or any sleep medicine.

Withdrawal: Withdrawal symptoms may occur when sleep medicines are stopped suddenly after being used daily for a long time. In some cases, these symptoms can occur even if the medicine has been used for only a week or two.

In mild cases, withdrawal symptoms may include unpleasant feelings. In more severe cases, abdominal and muscle cramps, vomiting, sweating, shakiness, and rarely, seizures may occur. These more severe withdrawal symptoms are very uncommon.

Another problem that may occur when sleep medicines are stopped is known as "rebound insomnia." This means that a person may have more trouble sleeping the first few nights after the medicine is stopped than before starting the medicine. If you should experience rebound insomnia, do not get discouraged. This problem usually goes away on its own after 1 or 2 nights.

If you have been taking Ambien CR or any other sleep medicine for more than 1 or 2 weeks, do not stop taking it on your own. Always follow your doctor's directions.

Changes in behavior and thinking: Some people using sleep medicines have experienced unusual changes in their thinking and/or behavior. These effects are not common. However, they have included:

- more outgoing or aggressive behavior than normal
- confusion
- strange behavior
- agitation
- hallucinations
- worsening of depression
- suicidal thoughts

How often these effects occur depends on several factors, such as a person's general health, the use of other medicines, and which sleep medicine is being used.

It is also important to realize that it is rarely clear whether these behavior changes are caused by the medicine, an illness, or occur on their own. In fact, sleep problems that do not improve may be due to illnesses that were present before the medicine was used. If you or your family notice any changes in your behavior, or if you have any unusual or disturbing thoughts, call your doctor immediately.

Pregnancy: Sleep medicines may cause sedation of the unborn baby when used during the last weeks of pregnancy.

Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR.

SAFE USE OF SLEEPING MEDICINES

To ensure the safe and effective use of Ambien CR or any other sleep medicine, you should observe the following cautions:

1. Ambien CR is a prescription medicine and should be used ONLY as directed by your doctor. Follow your doctor's instructions about how to take, when to take, and how long to take Ambien CR. Ambien CR tablets should not be divided, crushed, or chewed, and must be swallowed whole.
2. Never use Ambien CR or any other sleep medicine for longer than directed by your doctor.
3. If you notice any unusual and/or disturbing thoughts or behavior during treatment with Ambien CR or any other sleep medicine, contact your doctor.
4. Tell your doctor about any medicines you may be taking, including medicines you may buy without a prescription. You should also tell your doctor if you drink alcohol. DO NOT use alcohol while taking Ambien CR or any other sleep medicine.
5. Do not take Ambien CR unless you are able to get a full night's sleep before you must be active again. For example, Ambien CR should not be taken on an overnight airplane flight of less than 7 to 8 hours since "traveler's amnesia" may occur.
6. Do not increase the prescribed dose of Ambien CR or any other sleep medicine unless instructed by your doctor.
7. When you first start taking Ambien CR or any other sleep medicine, until you know whether the medicine will still have some carryover effect in you the next day, use extreme care while doing anything that requires complete alertness, such as driving a car, operating machinery, or piloting an aircraft.
8. Be aware that you may have more sleeping problems the first night after stopping Ambien CR or any other sleep medicine.
9. Be sure to tell your doctor if you are pregnant, if you are planning to become pregnant, or if you become pregnant while taking Ambien CR or any other sleep medicine.
10. As with all prescription medicines, never share Ambien CR or any other sleep medicine with anyone else. Always store Ambien CR or any other sleep medicine in the original container that you received it in and store it out of reach of children.
11. Ambien CR works very quickly. You should only take Ambien CR right before going to bed and are ready to go to sleep.

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VISIONS OF EARTH

Okefenokee Swamp, Georgia Though tipped with nightmare claws, the limbs of American alligators—this one photographed at a local park—are more often used to excavate wallowing holes than to slash at prey.

PHOTO: RICHARD T. BRYANT

Medellín, Colombia Wasting no time between bullfights, attendants tidy the trampled sand at the center of the 12,429-seat La Macarena arena as the carcass of the last bull slain is dragged from the ring.

PHOTO: HENRY AGUDELO

Uch Sharif, Pakistan A man kneels by a humble mud tomb, shadowed by ruins of Sufi shrines. Wracked by floods nearly 200 years ago, the shrines were once the heart of a famed center of Islamic learning.

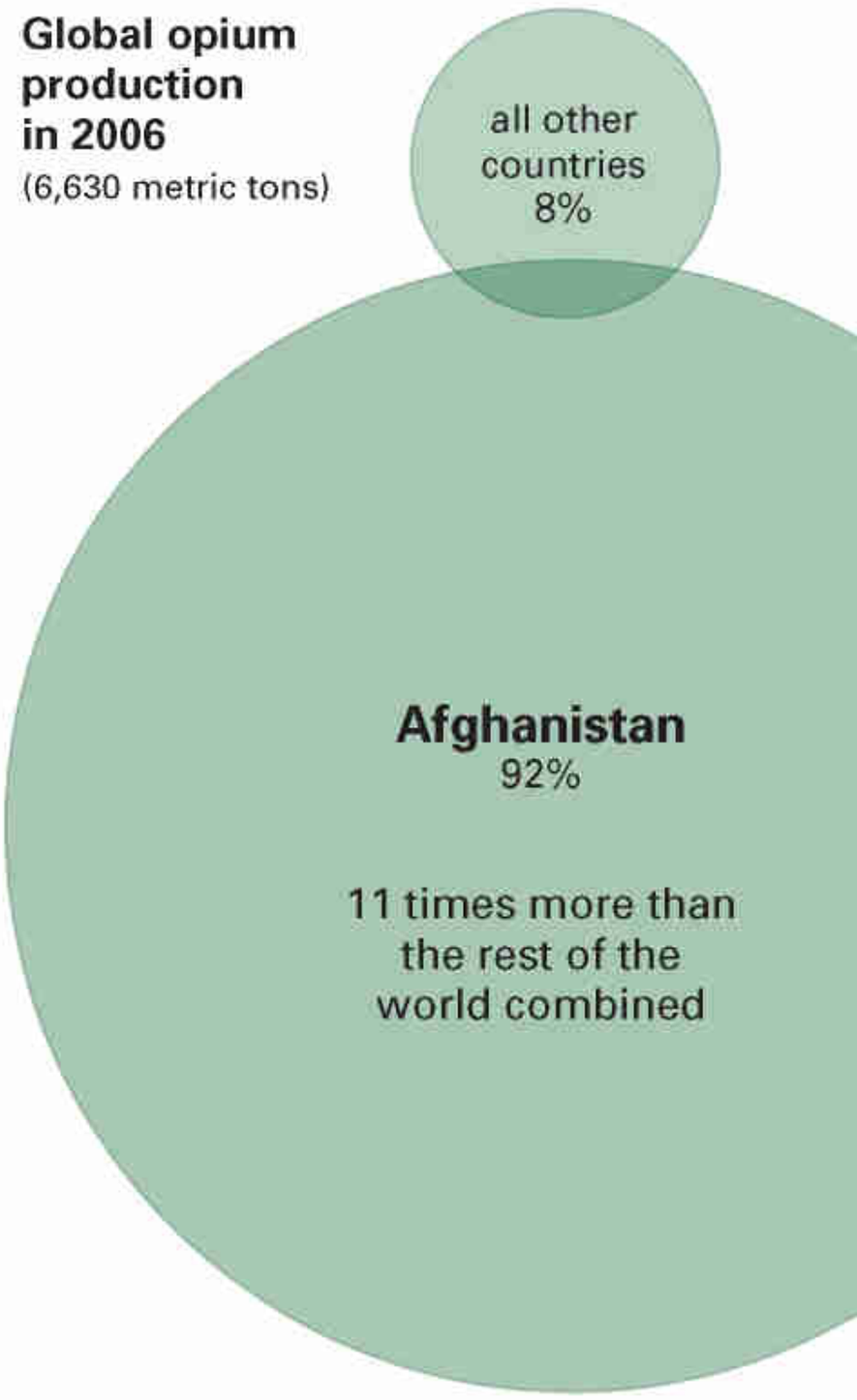
Decorate Your Desktop with Visions of Earth images in Fun Stuff at **ngm.com/0612.**

PHOTO: AARON HUEY

A sharecropper thins a poppy field near Jalalabad, Afghanistan.

The Persistent Poppy Afghanistan's war-shattered economy remains hooked on the poppy. The country is the world's top producer of opium—the dried gum extracted from poppy seedpods (below)—which is the primary ingredient in heroin. And a recent survey by the United Nations Office on Drugs and Crime revealed that the area under cultivation this year rose a whopping 59 percent over that in 2005. One effect has been a rise in the opiate addiction, which now afflicts 1.4 percent of Afghans ages 15-64, more than twice the U.S. rate. "Opium addiction among Afghan men is a source of major economic problems for their families," says Carol Yost of the Asia Foundation. "In a country where opportunities for women are limited, families are poorer when men become addicts."

In 2005, a government-led eradication effort curtailed poppy plantings but did little to reduce opium production, since good weather yielded a large harvest from the remaining plants. And with a field of poppies generating about nine times the income of a comparable field of wheat, poor farmers have little incentive to plant legal crops. *—Michael Klesius*



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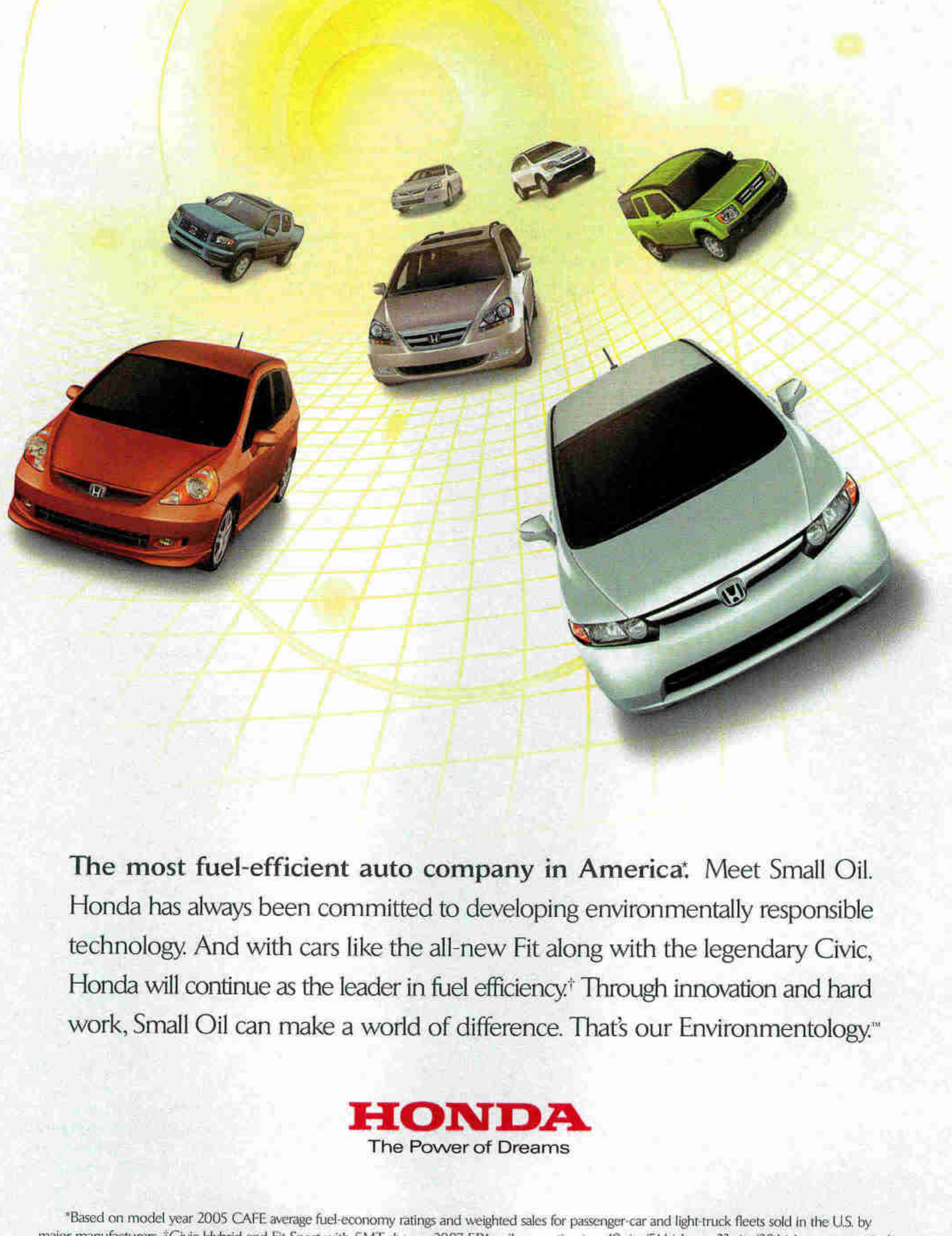

The most fuel-efficient auto company in America.* Meet Small Oil. Honda has always been committed to developing environmentally responsible technology. And with cars like the all-new Fit along with the legendary Civic, Honda will continue as the leader in fuel efficiency.† Through innovation and hard work, Small Oil can make a world of difference. That's our Environmentology.™

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*Based on model year 2005 CAFE average fuel-economy ratings and weighted sales for passenger-car and light-truck fleets sold in the U.S. by major manufacturers. †Civic Hybrid and Fit Sport with 5MT shown. 2007 EPA mileage estimates: 49 city/51 highway, 33 city/38 highway, respectively. Use for comparison purposes only. Actual mileage may vary. environmentology.honda.com

The Vaulting Pole

All compasses point to the north magnetic pole—but it might be time to trade that trusty compass for a handheld GPS. The north magnetic pole, unlike the stable geographic pole around which the planet spins, is hightailing it toward Siberia at a clip of 25 miles a year. Generated by movement of liquid iron coursing through Earth's outer core, the north magnetic pole has moved some 700 miles since its discovery in 1831. Oregon State University paleomagneticist Joseph Stoner's analysis of magnetic minerals in Arctic lake beds indicates that today's polar speeds are faster than any since the 15th century. The most notable impact of its wandering is likely to be on the pole's colorful halo, the aurora borealis, which may soon be more visible in Russia than Alaska. "A hundred years ago this movement could have been a major problem for navigation," Stoner says. "Now it's a minor inconvenience." —*Joel K. Bourne, Jr.*

SCALE VARIES IN THIS PERSPECTIVE.
NGM MAPS
PHOTO: ROYALTY FREE/CORBIS

People with COPD breathe better with SPIRIVA.

If you have a history of smoking and breathing problems, it could be COPD (chronic obstructive pulmonary disease). COPD includes chronic bronchitis and emphysema.

Ask your doctor about SPIRIVA, because it:

- ▲ Is the only once-daily, inhaled maintenance prescription treatment for COPD
- ▲ Helps you breathe better for a full 24 hours by keeping airways open
- ▲ Is not a steroid

SPIRIVA does not replace fast-acting inhalers for sudden symptoms. Tell your doctor about your medicines, including eye drops, and illnesses like glaucoma and urinary or prostate problems. These may worsen with SPIRIVA. Stop taking SPIRIVA and contact your doctor at once if you have vision changes, eye pain, sudden breathing problems, hives, or swelling of the throat or tongue. Side effects may include dry mouth, constipation, and problems passing urine.

SPIRIVA is one of several treatment options that you and your doctor can consider, along with making lifestyle changes. For more information, call 1.877.SPIRIVA or visit spiriva.com

Make a habit of breathing better

SPIRIVA® HandiHaler®
(tiotropium bromide inhalation powder)

Please see brief summary of full Prescribing Information on reverse.

SPIRIVA® HandiHaler®
(tiotropium bromide inhalation powder)

SPIRIVA® HandiHaler®
(tiotropium bromide inhalation powder)

For Oral Inhalation Only

Brief Summary of Prescribing Information

INDICATIONS AND USAGE

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is indicated for the long-term, once-daily, maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease (COPD), including chronic bronchitis and emphysema.

CONTRAINDICATIONS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is contraindicated in patients with a history of hypersensitivity to atropine or its derivatives, including ipratropium, or to any component of this product.

WARNINGS

SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is intended as a once-daily maintenance treatment for COPD and is not indicated for the initial treatment of acute episodes of bronchospasm, i.e., rescue therapy.

Immediate hypersensitivity reactions, including angioedema, may occur after administration of SPIRIVA. If such a reaction occurs, therapy with SPIRIVA should be stopped at once and alternative treatments should be considered.

Inhaled medicines, including SPIRIVA, may cause paradoxical bronchospasm. If this occurs, treatment with SPIRIVA should be stopped and other treatments considered.

PRECAUTIONS

General

As an anticholinergic drug, SPIRIVA (tiotropium bromide inhalation powder) may potentially worsen symptoms and signs associated with narrow-angle glaucoma, prostatic hyperplasia or bladder-neck obstruction and should be used with caution in patients with any of these conditions.

As a predominantly renally excreted drug, patients with moderate to severe renal impairment (creatinine clearance of ≤50 mL/min) treated with SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations**, *Renally-impaired Patients*).

Information for Patients

It is important for patients to understand how to correctly administer SPIRIVA capsules using the HandiHaler inhalation device (see **Patient's Instructions for Use**). SPIRIVA capsules should only be administered via the HandiHaler device and the HandiHaler device should not be used for administering other medications.

Capsules should always be stored in sealed blisters and only removed immediately before use. The blister strip should be carefully opened to expose only one capsule at a time. Open the blister foil as far as the *STOP* line to remove only one capsule at a time. The drug should be used immediately after the packaging over an individual capsule is opened, or else its effectiveness may be reduced. Capsules that are inadvertently exposed to air (i.e., not intended for immediate use) should be discarded.

Eye pain or discomfort, blurred vision, visual halos or colored images in association with red eyes from conjunctival congestion and corneal edema may be signs of acute narrow-angle glaucoma. Should any of these signs and symptoms develop, consult a physician immediately. Miotic eye drops alone are not considered to be effective treatment.

Care must be taken not to allow the powder to enter into the eyes as this may cause blurring of vision and pupil dilation.

SPIRIVA HandiHaler is a once-daily maintenance bronchodilator and should not be used for immediate relief of breathing problems, i.e., as a rescue medication.

Drug Interactions

SPIRIVA has been used concomitantly with other drugs commonly used in COPD without increases in adverse drug reactions. These include sympathomimetic bronchodilators, methylxanthines, and oral and inhaled steroids. However, the co-administration of SPIRIVA with other anticholinergic-containing drugs (e.g., ipratropium) has not been studied and is therefore not recommended.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

No evidence of tumorigenicity was observed in a 104-week inhalation study in rats at tiotropium doses up to 0.059 mg/kg/day, in an 83-week inhalation study in female mice at doses up to 0.145 mg/kg/day, and in a 101-week inhalation study in male mice at doses up to 0.002 mg/kg/day. These doses correspond to 25, 35, and 0.5 times the Recommended Human Daily Dose (RHDD) on a mg/m² basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies.

Tiotropium bromide demonstrated no evidence of mutagenicity or clastogenicity in the following assays: the bacterial gene mutation assay, the V79 Chinese hamster cell mutagenesis assay, the chromosomal aberration assays in human lymphocytes *in vitro* and mouse micronucleus formation *in vivo*, and the unscheduled DNA synthesis in primary rat hepatocytes *in vitro* assay.

In rats, decreases in the number of corpora lutea and the percentage of implants were noted at inhalation tiotropium doses of 0.078 mg/kg/day or greater (approximately 35 times the RHDD on a mg/m² basis). No such effects were observed at 0.009 mg/kg/day (approximately 4 times than the RHDD on a mg/m² basis). The fertility index, however, was not affected at inhalation doses up to 1.689 mg/kg/day (approximately 760 times the RHDD on a mg/m² basis). These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies.

Pregnancy

Pregnancy Category C

No evidence of structural alterations was observed in rats and rabbits at inhalation tiotropium doses of up to 1.471 and 0.007 mg/kg/day, respectively. These doses correspond to approximately 660 and 6 times the recommended human daily dose (RHDD) on a mg/m² basis. However, in rats, fetal resorption, litter loss, decreases in the number of live pups at birth and the mean pup weights, and a delay in pup sexual maturation were observed at inhalation tiotropium doses of ≥0.078 mg/kg (approximately 35 times the RHDD on a mg/m² basis). In rabbits, an increase in post-implantation loss was observed at an inhalation dose of 0.4 mg/kg/day (approximately 360 times the RHDD on a mg/m² basis). Such effects were not observed at inhalation doses of 0.009 and up to 0.088 mg/kg/day in rats and rabbits, respectively. These doses correspond to approximately 4 and 80 times the RHDD on a mg/m² basis, respectively. These dose multiples may be over-estimated due to difficulties in measuring deposited doses in animal inhalation studies.

There are no adequate and well-controlled studies in pregnant women. SPIRIVA should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Use in Labor and Delivery

The safety and effectiveness of SPIRIVA has not been studied during labor and delivery.

Nursing Mothers

Clinical data from nursing women exposed to tiotropium are not available. Based on lactating rodent studies, tiotropium is excreted into breast milk. It is not known whether tiotropium is excreted in human milk, but because many drugs are excreted in human milk and given these findings in rats, caution should be exercised if SPIRIVA is administered to a nursing woman.

Pediatric Use

SPIRIVA HandiHaler is approved for use in the maintenance treatment of bronchospasm associated with chronic obstructive pulmonary disease, including chronic bronchitis and emphysema. This disease does not normally occur in children. The safety and effectiveness of SPIRIVA in pediatric patients have not been established.

Geriatric Use

Of the total number of patients who received SPIRIVA in the 1-year clinical trials, 426 were <65 years, 375 were 65-74 years and 105 were ≥75 years of age. Within each age subgroup, there were no differences between the proportion of patients with adverse events in the SPIRIVA and the comparator groups for most events. Dry mouth increased with age in the SPIRIVA group (differences from placebo were 9.0%, 17.1%, and 16.2% in the aforementioned age subgroups). A higher frequency of constipation and urinary tract infections with increasing age was observed in the SPIRIVA group in the placebo-controlled studies. The differences from placebo for constipation were 0%, 1.8%, and 7.8% for each of the age groups. The differences from placebo for urinary tract infections were –0.6%, 4.6% and 4.5%. No overall differences in effectiveness were observed among these groups. Based on available data, no adjustment of SPIRIVA dosage in geriatric patients is warranted.

ADVERSE REACTIONS

Of the 2,663 patients in the four 1-year and two 6-month controlled clinical trials, 1,308 were treated with SPIRIVA (tiotropium bromide inhalation powder) at the recommended dose of 18 mcg once a day. Patients with narrow angle glaucoma, or symptomatic prostatic hypertrophy or bladder outlet obstruction were excluded from these trials.

The most commonly reported adverse drug reaction was dry mouth. Dry mouth was usually mild and often resolved during continued treatment. Other reactions reported in individual patients and consistent with possible anticholinergic effects included constipation, increased heart rate, blurred vision, glaucoma, urinary difficulty, and urinary retention.

Four multicenter, 1-year, controlled studies evaluated SPIRIVA in patients with COPD. Table 1 shows all adverse events that occurred with a frequency of ≥3% in the SPIRIVA group in the 1-year placebo-controlled trials where the rates in the SPIRIVA group exceeded placebo by ≥1%. The frequency of corresponding events in the ipratropium-controlled trials is included for comparison.

Table 1: Adverse Experience Incidence (% Patients) in One-Year-COPD Clinical Trials

Body System (Event)	Placebo-Controlled Trials		Ipratropium-Controlled Trials	
	SPIRIVA [n=550]	Placebo [n=371]	SPIRIVA [n=356]	Ipratropium [n=179]
Body as a Whole				
Accidents	13	11	5	8
Chest Pain (non-specific)	7	5	5	2
Edema, Dependent	5	4	3	5
Gastrointestinal System Disorders				
Abdominal Pain	5	3	6	6
Constipation	4	2	1	1
Dry Mouth	16	3	12	6
Dyspepsia	6	5	1	1
Vomiting	4	2	1	2
Musculoskeletal System				
Myalgia	4	3	4	3
Resistance Mechanism Disorders				
Infection	4	3	1	3
Moniliasis	4	2	3	2
Respiratory System (upper)				
Epistaxis	4	2	1	1
Pharyngitis	9	7	7	3
Rhinitis	6	5	3	2
Sinusitis	11	9	3	2
Upper Respiratory Tract Infection	41	37	43	35
Skin and Appendage Disorders				
Rash	4	2	2	2
Urinary System				
Urinary Tract Infection	7	5	4	2

Arthritis, coughing, and influenza-like symptoms occurred at a rate of ≥3% in the SPIRIVA treatment group, but were <1% in excess of the placebo group.

Other events that occurred in the SPIRIVA group at a frequency of 1-3% in the placebo-controlled trials where the rates exceeded that in the placebo group include: *Body as a Whole:* allergic reaction, leg pain; *Central and Peripheral Nervous System:* dysphonia, paresthesia; *Gastrointestinal System Disorders:* gastrointestinal disorder not otherwise specified (NOS), gastroesophageal reflux, stomatitis (including ulcerative stomatitis); *Metabolic and Nutritional Disorders:* hypercholesterolemia, hyperglycemia; *Musculoskeletal System Disorders:* skeletal pain; *Cardiac Events:* angina pectoris (including aggravated angina pectoris); *Psychiatric Disorder:* depression; *Infections:* herpes zoster; *Respiratory System Disorder (Upper):* laryngitis; *Vision Disorder:* cataract. In addition, among the adverse events observed in the clinical trials with an incidence of <1% were atrial fibrillation, supraventricular tachycardia, angioedema, and urinary retention.

In the 1-year trials, the incidence of dry mouth, constipation, and urinary tract infection increased with age (see **PRECAUTIONS, Geriatric Use**).

Two multicenter, 6-month, controlled studies evaluated SPIRIVA in patients with COPD. The adverse events and the incidence rates were similar to those seen in the 1-year controlled trials.

The following adverse reactions have been identified during worldwide post-approval use of SPIRIVA: dizziness, epistaxis, hoarseness, palpitations, pruritus, tachycardia, throat irritation, and urticaria.

DOSAGE AND ADMINISTRATION

The recommended dosage of SPIRIVA HandiHaler (tiotropium bromide inhalation powder) is the inhalation of the contents of one SPIRIVA capsule, once-daily, with the HandiHaler inhalation device (see **Patient's Instructions for Use**).

No dosage adjustment is required for geriatric, hepatically-impaired, or renally-impaired patients. However, patients with moderate to severe renal impairment given SPIRIVA should be monitored closely (see **CLINICAL PHARMACOLOGY, Pharmacokinetics, Special Populations and PRECAUTIONS**).

SPIRIVA capsules are for inhalation only and must not be swallowed.

HOW SUPPLIED

The following packages are available:

carton containing 6 SPIRIVA capsules (1 blister card) and 1 HandiHaler inhalation device (NDC 0597-0075-06)

carton containing 30 SPIRIVA capsules (5 blister cards) and 1 HandiHaler inhalation device (NDC 0597-0075-37)

℞ only

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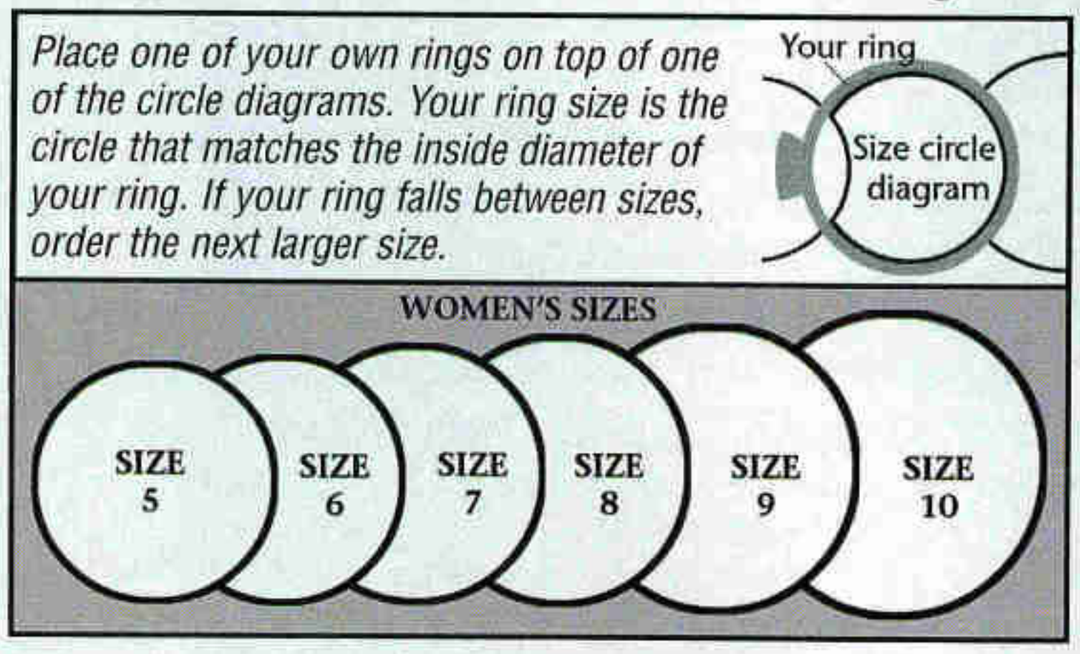
Place one of your own rings on top of one of the circle diagrams. Your ring size is the circle that matches the inside diameter of your ring. If your ring falls between sizes, order the next larger size.



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The Codex Borgia (top) and the Codex Fejérváry-Mayer (above) date from about A.D. 1500.

Decoding Destiny In the realm of the ancient Aztec, books of symbols painted on deerskin or bark paper cataloged the supernatural forces that governed every aspect of life. Specially trained readers, called calendar priests or day keepers, decoded the symbols to help people navigate the maze of influences associated with each day, each 13-day week, and each year. After a birth, new parents would visit a day keeper for a reading of the baby's fate. And for all of life's major decisions thereafter—planning a journey, perhaps, or choosing a mate—a day keeper could offer guidance.

Reproductions of two of the nine surviving books of fate are shown here. In the Codex Borgia (above) each block represents a day. At the upper left, the day's divine patron (on the throne) is a god of prosperity. "A great day to have a wedding," says Tulane University's Elizabeth Boone, who has just completed a new study of the books. The Codex Fejérváry-Mayer (left) compiles all the days on its first page, then details specific rituals. To guard against a scorpion, spider, wasp, snake, prickly bush, or even a jaguar, offering a ball of rubber and a bundle of kindling should work wonders. *—A. R. Williams*

PHOTOS: JOSEPH MILLS, AKADEMISCHE DRUK-U. VERLAGSANSTALT

We gave them the new Nikon® D80.™ What they gave back was stunning.

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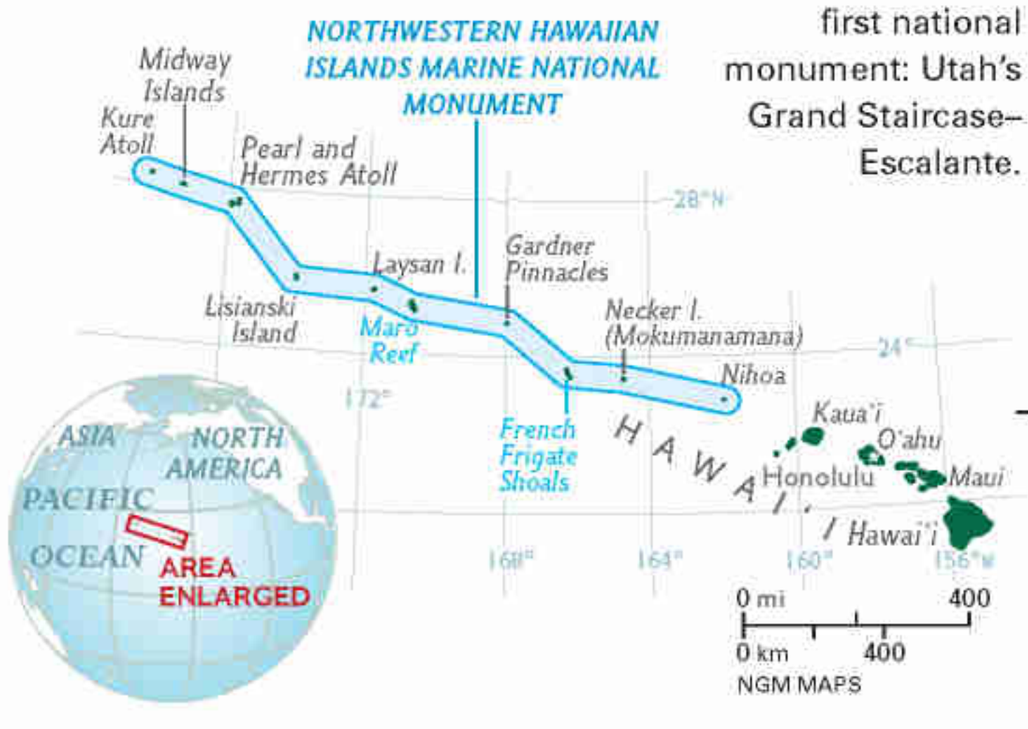
ENVIRONMENT

Masked boobies on Hawaii's protected Pearl and Hermes Atoll

Words Create Worlds When Congress drafted an "act for the preservation of American antiquities" in 1906, the bill had a relatively modest goal: to stop the vandalism and theft of ancient Native American artifacts in America's Southwest. But the legislation's language helped it evolve into something far bigger. The act gave the President authority to protect objects of historic or scientific interest by designating them as national monuments. Realizing the power Congress had just given him, President Theodore Roosevelt thought big—setting aside 18 different sites as national monuments, including Muir Woods in California and Arizona's Petrified Forest. This year President George W. Bush invoked the act to establish the Northwestern Hawaiian Islands Marine National Monument, at nearly 140,000 square miles the largest marine sanctuary in the world (photo above and map).

A century after its creation, the Antiquities Act remains a legacy of the Progressive era, a way for the President to quickly protect the public interest by saving a national treasure. *—Alan Mairson*



A Century of Conservation
Fifteen of the past 18 U.S. Presidents have invoked the Antiquities Act.

1906
Three months after the passage of the Antiquities Act, Theodore Roosevelt names Devils Tower the first U.S. national monument.

1908
Roosevelt deems 800,000 acres of the Grand Canyon an "object of unusual scientific interest."

1915
Woodrow Wilson adds Dinosaur National Monument to the list of protected places.

1924
The Statue of Liberty gets national monument status 38 years after its dedication. Ellis Island is incorporated as part of the monument in 1965.

1943
The National Park Service is sued over creation of Jackson Hole National Monument. The park service prevails.

1978
President Jimmy Carter sets aside 56 million acres of Alaska wilderness —effectively doubling the size of the National Park System.

1996
President Bill Clinton names his first national monument: Utah's Grand Staircase–Escalante.

2001
Days before leaving office, Clinton designates seven more monuments, bringing his Presidency's total to 19.

2006
President George W. Bush creates Northwestern Hawaiian Islands Marine National Monument.

PHOTOS: SUSAN MIDDLETON (TOP LEFT); CORBIS (TOP RIGHT); HERBERT SPICHTINGER, ZEFA/CORBIS

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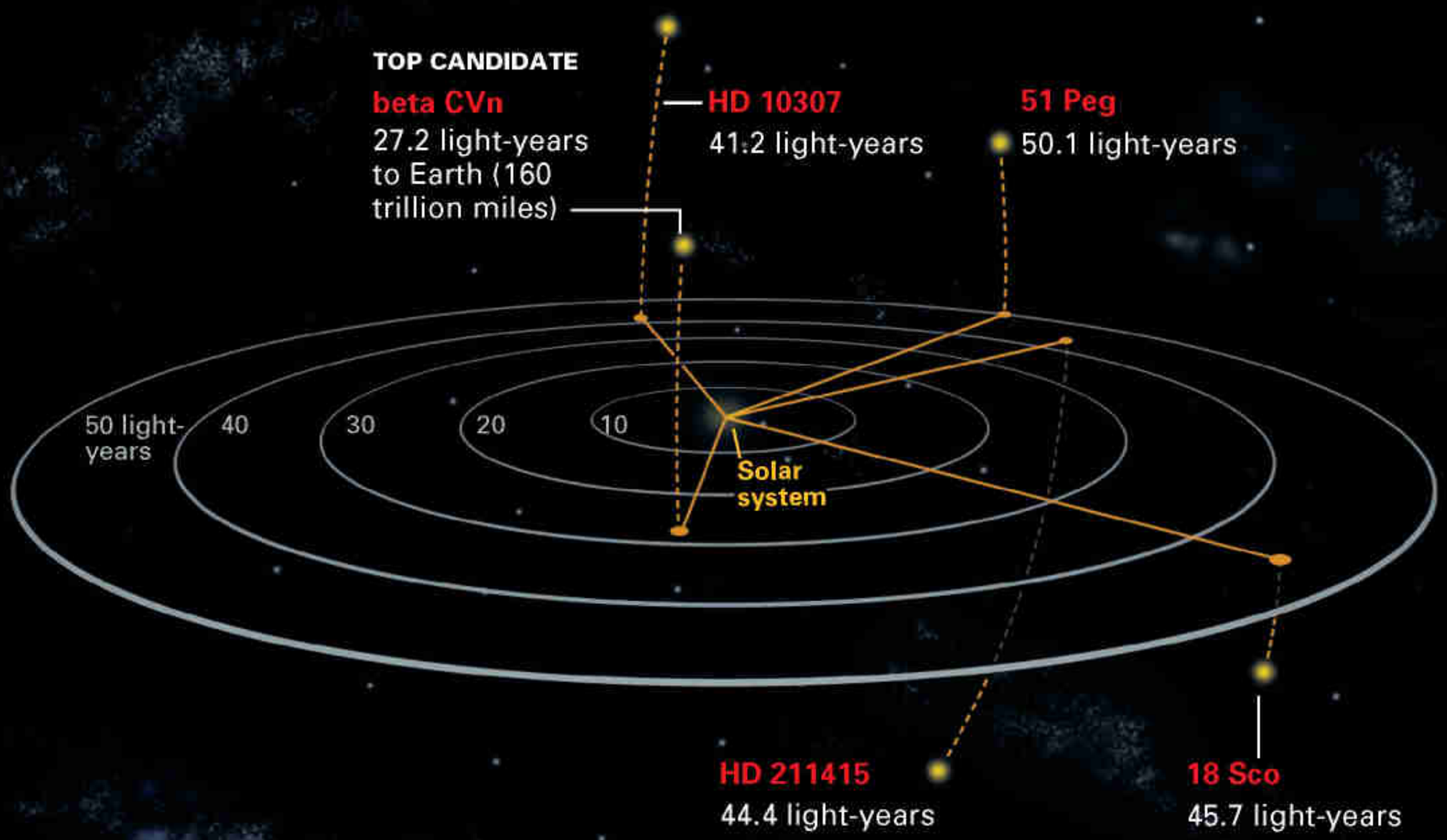
Stars Like Ours

In the search for intelligent life out there, it helps to know where to look and listen. Here are five stars within 300 trillion miles, about 50 light-years, of our solar system that match the sun on a list of key requirements (bottom). These stars might harbor a rocky, Earth-like planet—not yet discovered due to limits in technology—where liquid water could give rise to life, says astronomer Margaret Turnbull of the Carnegie Institution of Washington. The Search for Extraterrestrial Intelligence Institute has tuned antennas in these stars' direction, hoping to detect radio transmissions from complex beings. "We no longer look up to the stars, but out from among them," says Turnbull. "These are our potential homes away from home." *—Michael Klesius*



The requirements

		REASON
Age	Cannot be younger than 3 billion years	Creates time frame long enough for life to proliferate
Mass	No larger than 1.5 times the sun's mass	Larger stars burn out too quickly
Metal content	At least 50 percent of the sun's iron content	Enough heavy metal for rocky planets to form
Location	Stable location between galaxy's spiral arms	Less likely to pass through interstellar dust and star-forming regions, causing climate change
Stability	Cannot be a variable star	Such stars are prone to flares and changes in brightness that wreak havoc on planetary climates
Multiplicity	Stars in a multiple star system must be very close together or very far apart	Otherwise, the stars' gravity would interfere with the orbits of planets suitable for life

GRAPHICS SOURCE: MARGARET TURNBULL, CARNEGIE INSTITUTION OF WASHINGTON

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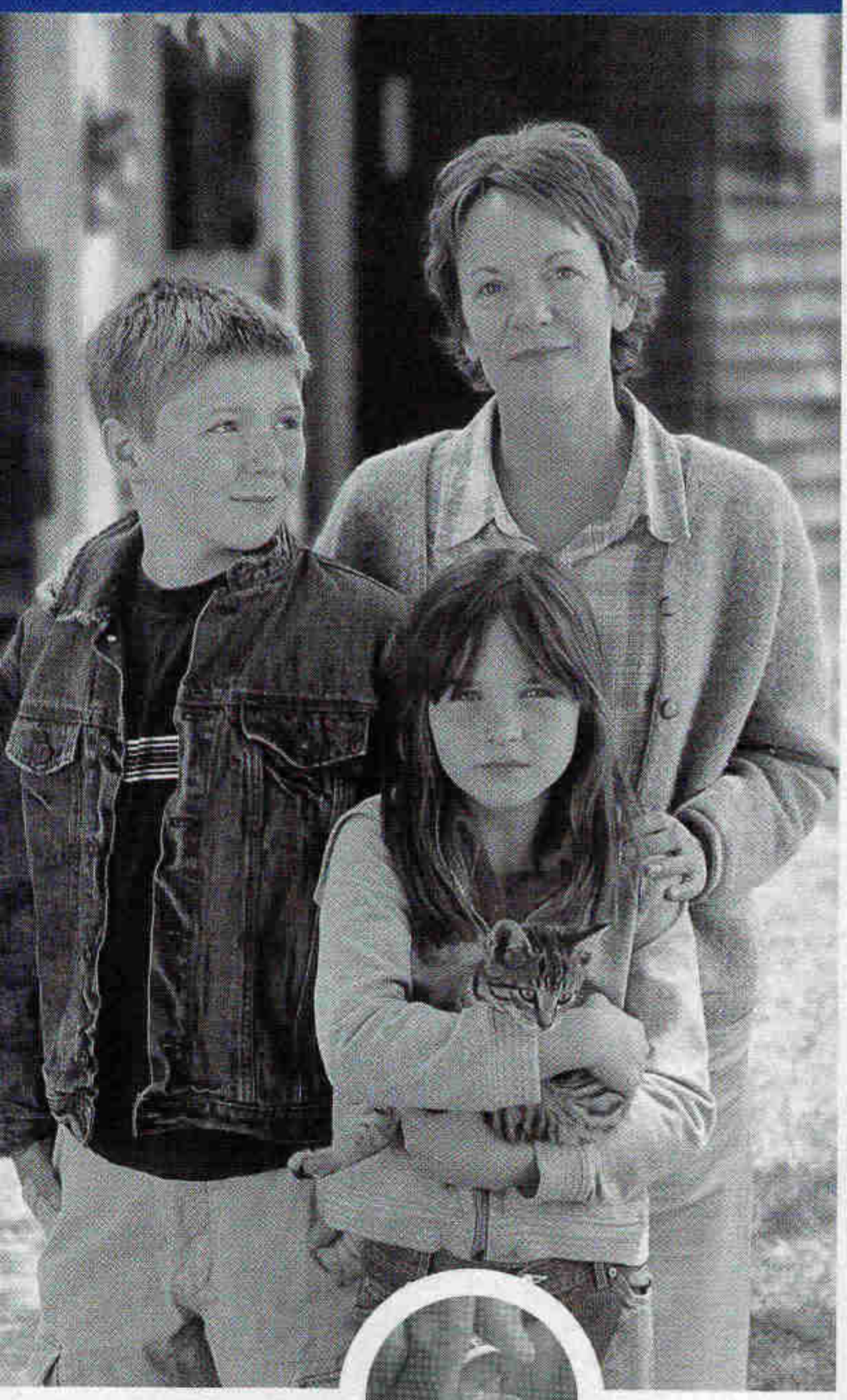

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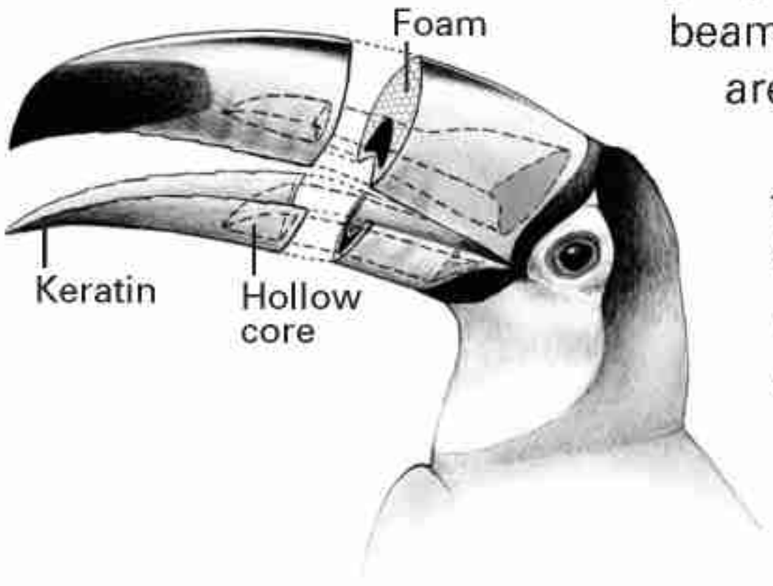
Where patients come first MERCK

Power Beak It seems a wonder that toucans don't fall on their faces, so enormous are the beaks of these South American birds. One large species, the toco toucan, has an orange-yellow bill six to nine inches long, about a third of the bird's length.

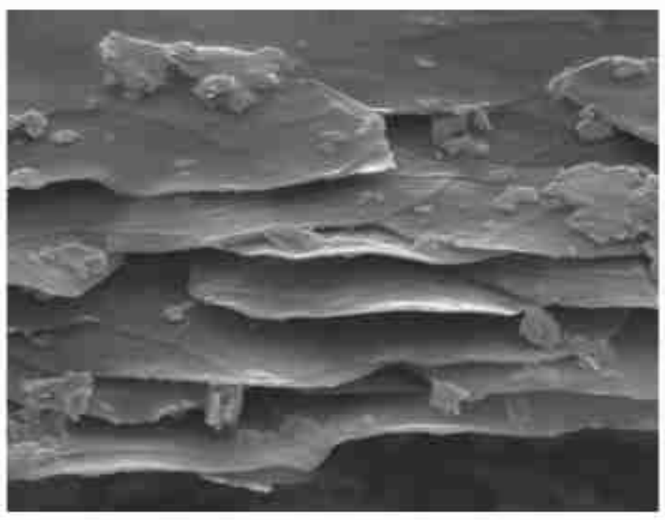
But the toucan's beak is ingeniously designed to be both strong and light. Marc André Meyers, a materials scientist at the University of California, San Diego, thinks its two-part construction could be adapted for use in the automotive and aviation industries to offer protection from crashes.

"Toucan beaks are beautiful structures," he says. "The surface is made of keratin, the same material in fingernails and hair. But the outer layer isn't a solid structure. It's actually many layers of tiny hexagonal plates, overlapping like shingles on a roof. The interior is different from the shell, made of bone. It consists of a light yet rigid foam made of little beams and membranes. And some areas of the beak are hollow."



Born in Brazil, Meyers sometimes went hunting with his father and once found the skull of a toucan. "The beak was so strong and light; I stored the idea away for years," he says. —*John L. Eliot*

Interior Hard "foam" cells inside the beak help make it lightweight.



Exterior Shingled layers of keratin toughen the outside of the beak.

PHOTOS: NORBERT WU, MINDEN PICTURES (TOP); MARC A. MEYERS, UCSD JACOBS SCHOOL OF ENGINEERING (CENTER AND ABOVE). ART: SHAWN GOULD (LEFT)

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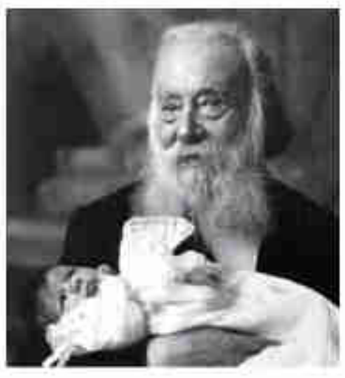
By the Numbers The United States population passed the 300 million mark this year. A look back at census data from 1915 and 1967, when the population hit 100 million and 200 million, can't reveal the whole story of elections and wars and social revolutions, but it does provide a glimpse of some of the ways U.S. life has changed. *—Siobhan Roth*

	1915	1967	2006
U.S. POPULATION	100 million	200 million	300 million
 **WORLD POPULATION**	1.8 billion	3.5 billion	6.5 billion
FOREIGN-BORN POPULATION IN U.S.	13.5 million (largely from Germany)	9.7 million (largely from Italy)	34.3 million (largely from Mexico)
 **LIFE EXPECTANCY**	54.5 years	70.5 years	77.8 years
PEOPLE 65 OR OLDER	4.5 million	19.1 million	36.8 million
 **ANNUAL EARNINGS**	$687 ($13,284 in 2005 dollars)	Men: $5,974 Women: $2,295 ($29,589 and $11,367 in 2005 dollars)	Men: $34,926 Women: $23,546
WOMEN WORKING	23%	41%	59%
 **HOME OWNERSHIP**	45.9%	63.6%	68.9%
PRICE OF A NEW HOME	$3,200 ($64,158 in 2006 dollars)	$24,600 ($149,147 in 2006 dollars)	$290,600
 **REGISTERED VEHICLES**	2.5 million	98.9 million	237.2 million
A GALLON OF REGULAR GAS	$0.25 ($5.01 in 2006 dollars)	$0.33 ($2.00 in 2006 dollars)	$3.04 (As of Aug. 7)
 **A GALLON OF MILK**	$0.36 ($7.22 in 2006 dollars)	$1.03 ($6.24 in 2006 dollars)	$3.00
CHILDREN PER HOUSEHOLD	1.90	1.41	0.94

SOURCES: U.S. CENSUS BUREAU; BUREAU OF LABOR STATISTICS. DATA IS CLOSEST AVAILABLE TO HIGHLIGHTED YEAR.
PHOTOS (FROM TOP): KAREN KASMAUSKI; THE BELL FAMILY; LIBRARY OF CONGRESS; BOB KRIST; SARAH LEEN; J. BAYLOR ROBERTS

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Panerai Tested at the North Pole

Mike Horn

Officine Panerai becomes a protagonist of the North Pole Winter Expedition on the wrists of Mike Horn and Børge Ousland.

2006 started with a new adventure for Horn. After the 2005 Arktos Expedition, his solo circumnavigation of the Arctic Circle, which took two years to complete, he then turned his attention to the North Pole Winter Expedition, the objective of which was to travel across the thousand or more kilometers of ice that separate the northernmost part of Russia from the North Pole.

This expedition had never been attempted before and it took place in winter, without any sunlight but with the fragility of the polar ice cap strengthened by the very low temperature (around -40°C). Horn made the North Pole Winter Expedition in company with Ousland, a Norwegian explorer who, like the South African Horn, has long experience of the cold Arctic regions.

Officine Panerai, an exclusive partner of the North Pole Winter Expedition, has developed a technically advanced watch, the Panerai Luminor GMT North Pole, which has been tested in the course of this hazardous but fascinating expedition. The watch has a steel case with the characteristic bridge protecting the winding crown (an Officine Panerai patent) and an additional internal case made of soft iron, a material which protects the mechanism from the influence of the Earth's magnetic field, the intensity of which increases considerably in the vicinity of the North Pole. The calibre OP VIII, with automatic winding, has been lubricated with special oils to guarantee the best performance even close to the North Pole. The screw back has been personalized with a diagram of the expedition.

The special feature of the Panerai Luminor GMT North Pole is its rotating bezel with the applied letters of the four cardinal points. This is a practical solution that enables the wearer's position to be established by observation of the stars. It is a simple instrument that can be used in the conditions of total darkness in which Horn and Ousland found themselves, and it was a fundamental system of orientation in the context of an environment that prevents the operation of equipment such as the compass and GPS because of the extremely severe cold. Blue in color to make reading the information easier, the dial indicates both the time and the date while the second time zone is indicated by an additional hand.

specs

CASE: In three parts, diameter 44 mm, in steel with supplementary antimagnetic case of soft iron. Device protecting the winding crown (registered Trade Mark), sapphire crystal, 3 mm thick, with antireflective treatment, magnifying lens for the date applied internally to the crystal at 3 o'clock

BEZEL: In steel, with the four letters of the cardinal points applied

CASEBACK: Screw back in steel with a diagram showing the polar ice cap and the course of the North Pole Winter Expedition, accompanied by the signatures of Mike Horn and Børge Ousland

WATER-RESISTANCE: To 300 meters

MOVEMENT: Automatic mechanical, Panerai calibre OP VIII, 131/4 lignes, 21 jewels. Glucydur® balance with three arms, operating frequency 28,800 vibrations/hour. Incabloc® antishock device. Power reserve of 42 hours. Chronometer Certificate (COSC)

FUNCTIONS: Hours, minutes, seconds, date, and second time zone

DIAL: Blue with luminous numerals and markers, small seconds at 9 o'clock, date window at 3 o'clock, second time zone indication on the outer edge

STRAP: Water-resistant Velcro

REFERENCE: PAM00252

Officine Panerai is not the owner of the trademarks Incabloc® and Glucydur®.

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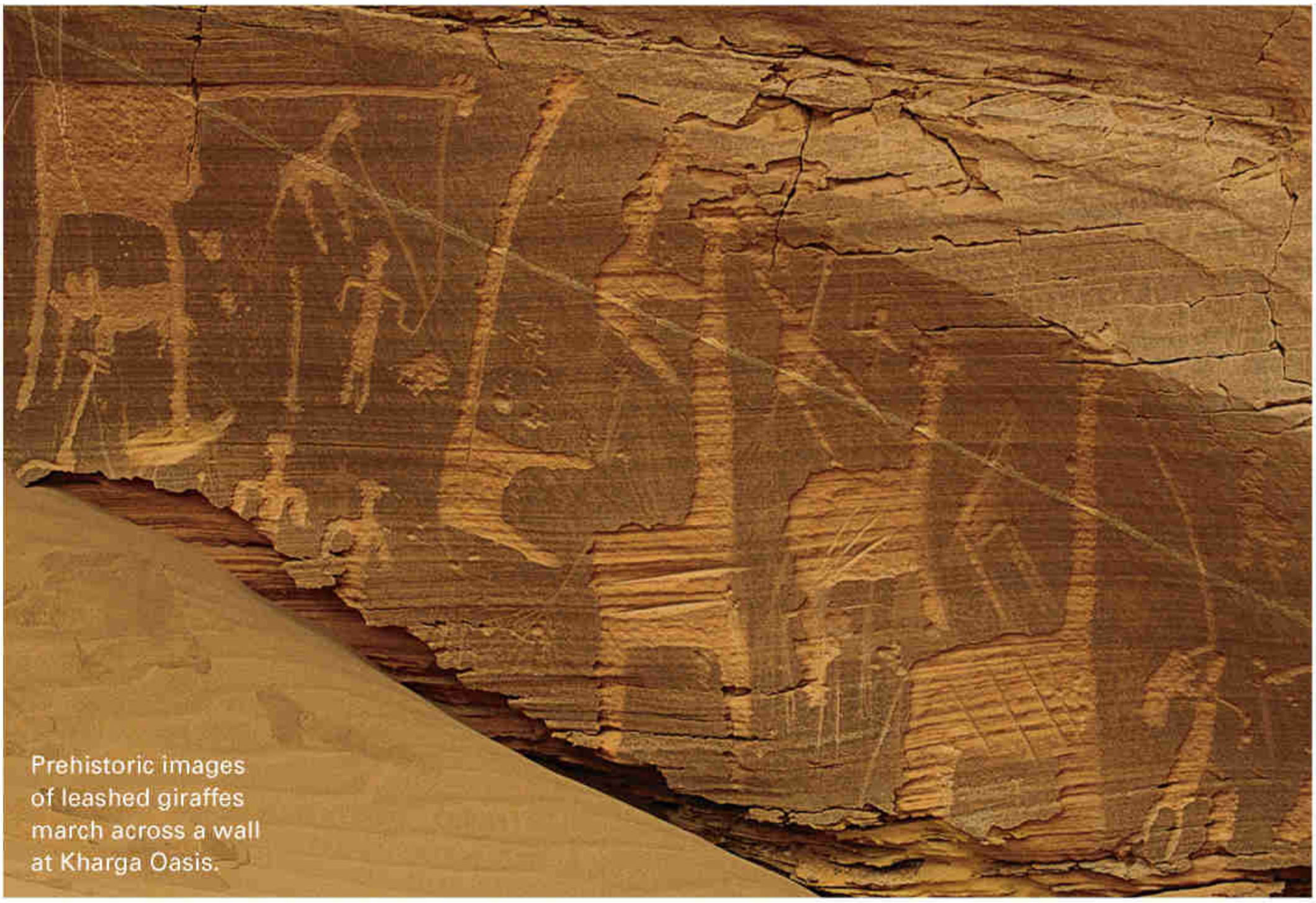

Prehistoric images of leashed giraffes march across a wall at Kharga Oasis.

NG GRANTEE **Caravan Crossroads** Kharga Oasis lies in the middle of nowhere, on the way to everywhere, in Egypt's sun-hammered Western Desert. Between the second and fourth centuries A.D., Romans settled the oasis as a frontier outpost, guarded by imposing mud-brick forts such as Umm el-Dabadib (below). Soldiers stationed there repelled nomadic raiders, protected the fields that helped feed Egypt and Rome, and collected taxes from caravans hauling gold, ostrich feathers, ebony, ivory, and slaves to the Nile Valley.

People used the oasis long before the Romans, of course—and much earlier than previously known. Along the old east-west trade route, archaeologists Salima Ikram and Corinna Rossi found countless galleries of graffiti that travelers scratched into sandstone—from the dawn of the ancient dynasties to modern times. A big surprise were the images of giraffes on leashes (top) likely etched by oasis residents when the land was still a savanna, around 6000 B.C. "The word for giraffe in hieroglyphs also means to foretell," says Ikram. "Maybe people thought giraffes were good at finding water." *—A. R. Williams*

Kharga's graffiti include:

- **Animals** such as snakes, elephants, dogs, birds, bulls, oryx, and fish
- **The name of an early, unknown king** called Aa, from about 3100 B.C.
- **An ankh sign** with three human figures, perhaps travelers invoking protection from desert hazards
- **A man** portrayed with upraised hands

PHOTOS: KENNETH GARRETT

Ordinary day

Incredible evening

MARVEL ©™ Marvel 2006. The Hulk movie: © 2003 Universal Studios

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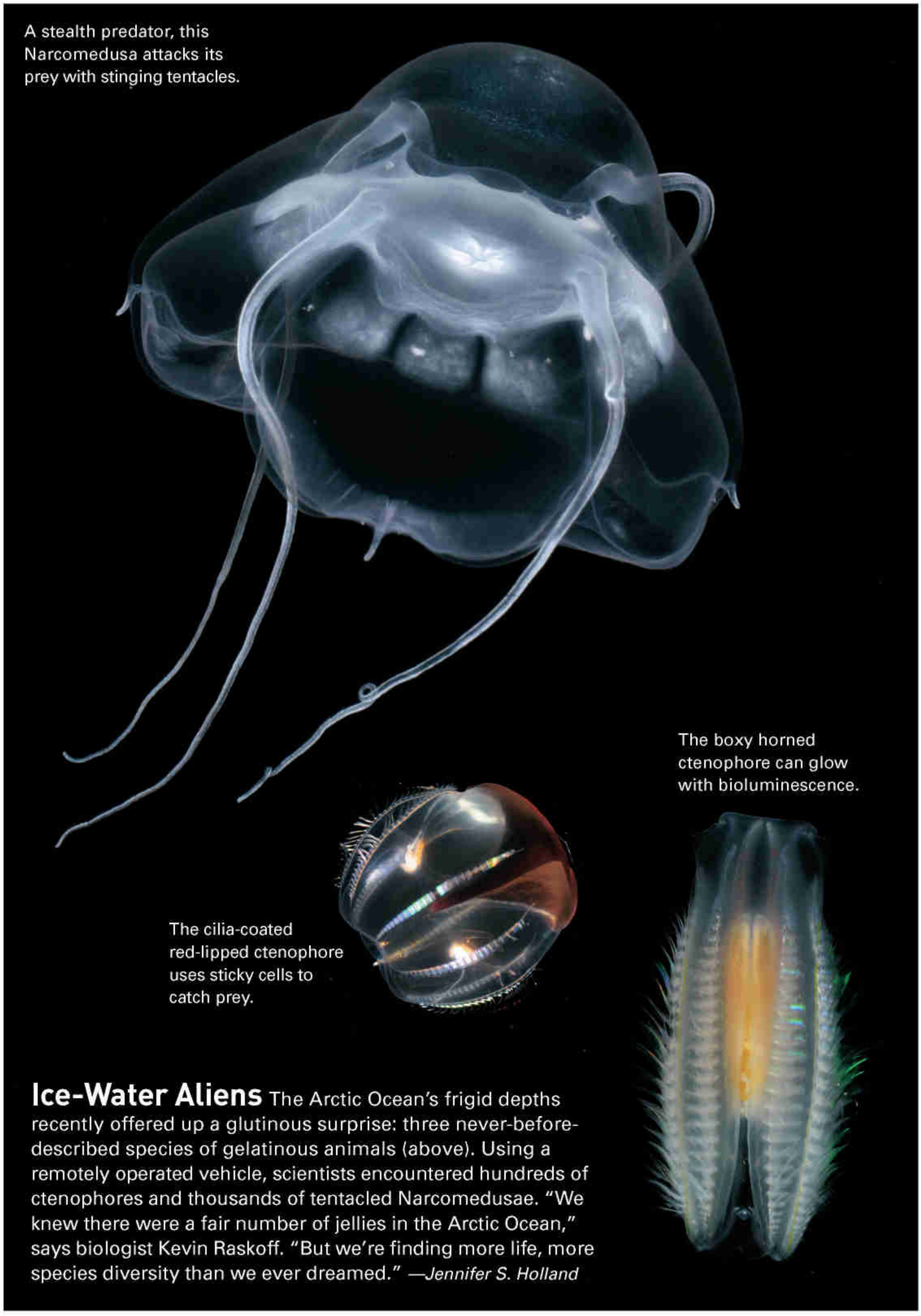
A stealth predator, this Narcomedusa attacks its prey with stinging tentacles.



The boxy horned ctenophore can glow with bioluminescence.

The cilia-coated red-lipped ctenophore uses sticky cells to catch prey.

Ice-Water Aliens The Arctic Ocean's frigid depths recently offered up a glutinous surprise: three never-before-described species of gelatinous animals (above). Using a remotely operated vehicle, scientists encountered hundreds of ctenophores and thousands of tentacled Narcomedusae. "We knew there were a fair number of jellies in the Arctic Ocean," says biologist Kevin Raskoff. "But we're finding more life, more species diversity than we ever dreamed." *—Jennifer S. Holland*

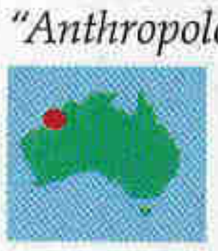
PHOTOS: KEVIN RASKOFF

Australia

Meet the experts

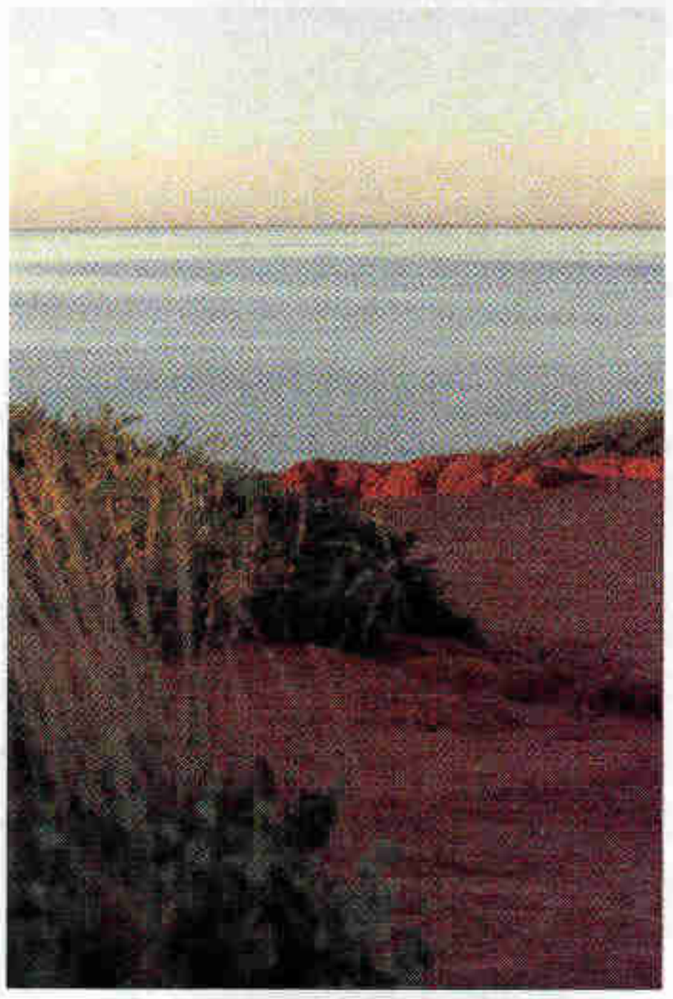
With more of us exploring the globe than ever before, there's an increasing awareness of the impact we make on the places we visit—and the lessons we can learn from them while we're there. Australia has been at the forefront of responsible travel for several years now, and there are many projects around the continent working in harmony with the environment—and contributing to the communities where they're based.

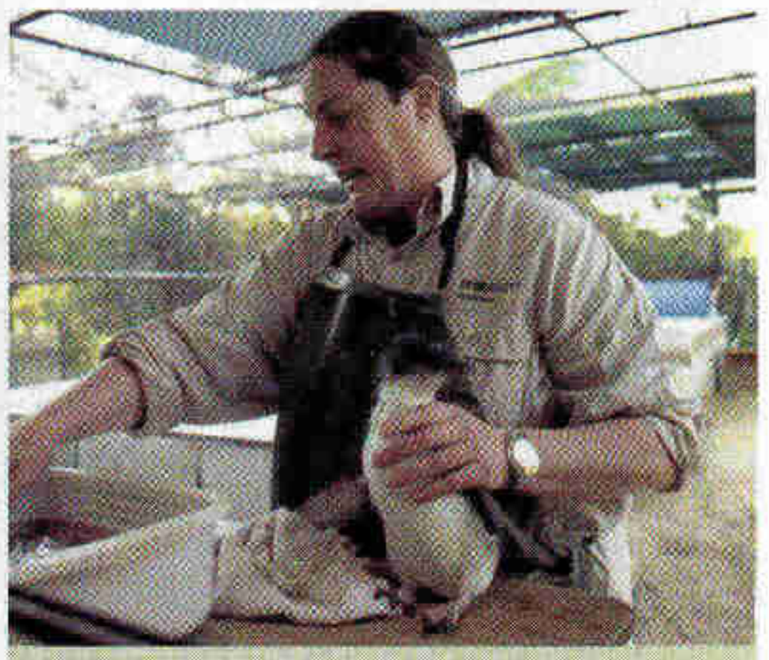
Micklo Corpus
"Anthropologist"



Broome, Western Australia

"This is the original site for human beings in Australia," says Micklo Corpus, the ranger at Minyirr Park, Broome, in Western Australia. According to indigenous history it is the place where the Aboriginal ancestors rose from the reef and began roaming the Earth. Micklo has lived here his whole life and can tell you everything there is to know about this fascinating place. Each July, he accompanies a nine-day, 180-kilometer walk from Minyirr Park to Mannarriny (Coulomb Point), in the north. Anyone can come along with him. Along the way you'll sleep under the stars and feast on bush tucker—as well as get a rare glimpse of Aboriginal culture. By the end of it, you'll be well on the way to becoming an expert yourself . . .





Marg Healy
"Ornithologist"

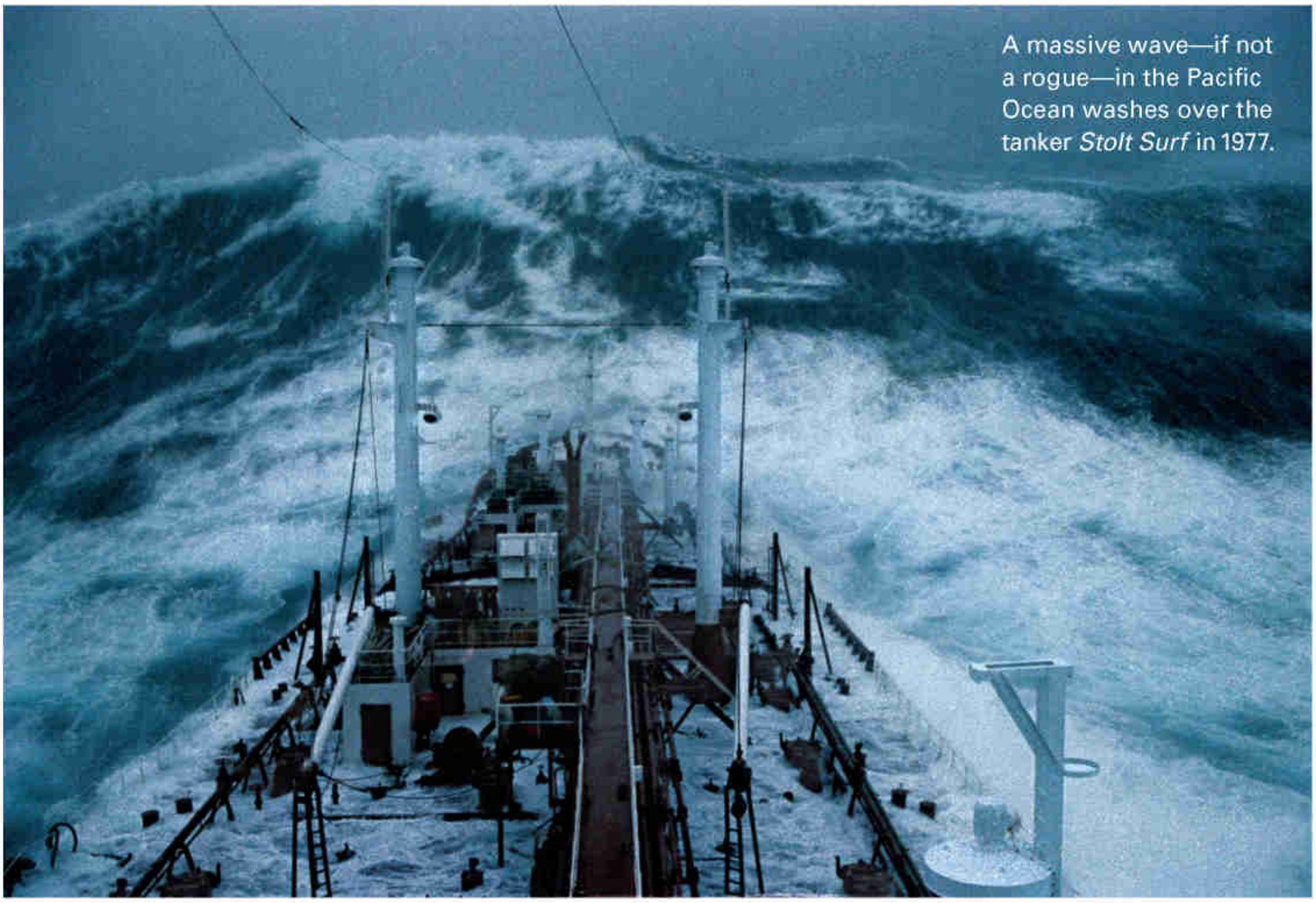
Phillip Island, Victoria

"The penguins pay for this place themselves," says Marg Healy, Wildlife Rehabilitation Officer at the Penguin Hospital on Phillip Island, Victoria. Marg is referring to the famous Penguin Parade, which sees a colony of little penguins—the smallest species on the planet—march up the beach to their sand dune burrows. Hundreds of thousands of people come here every year, just to see the penguins strut their stuff—generating AUD$12 million in revenue. Much of this money goes into educational and research programs, as well as protection of the penguins' habitat. It also helps fund the nearby penguin hospital, where most of Marg's work takes place. Completely self-taught, she cares for hundreds of injured penguins a year. We caught up with her as she gave her two latest patients their morning feed.

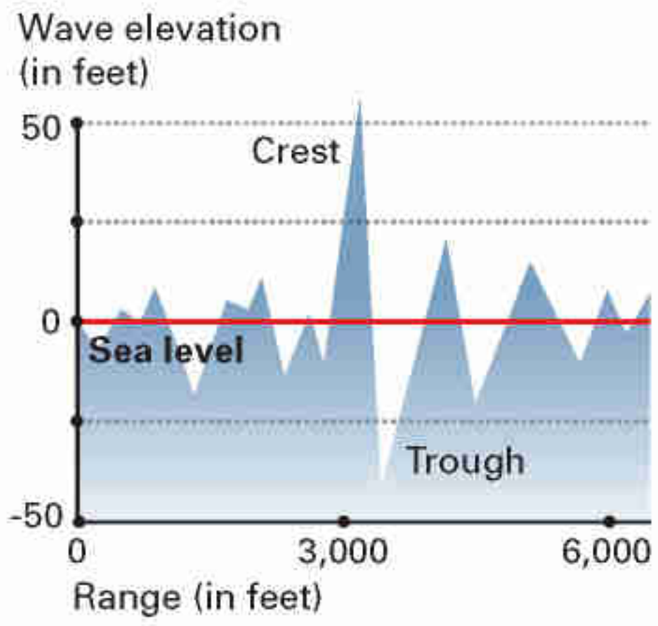
For more information go to
www.nationalgeographic.com/australia
www.ngm.com/kakaducam

Top left: A chat with Micklo Corpus is a fascinating lesson in Aboriginal history. Left: The earth at Minyirr Park is famous for its unique pink pigment known as pindan. Above: Marg Healy with one of her patients

ENVIRONMENT



A massive wave—if not a rogue—in the Pacific Ocean washes over the tanker *Stolt Surf* in 1977.



A 95-foot swell, the highest seen by MaxWave, puts a spike in the data.

Rogue Waves Appearing out of nowhere, ten stories tall, rogue waves, the ship-wrecking swells of seafaring lore, are not only real but also frequent. About six years ago, the European Union launched MaxWave, a project to measure the size of ocean waves around the world, using radar data collected by satellites over the past decade. The orbiting craft had peered down through clouds and darkness, recording wave activity every 124 miles. Researchers studied data from 27 various days and found 10 waves that fell more than 80 feet from crest to trough. Often, these giants occurred near weather fronts or where ocean currents amplify opposing swells. A new project is now logging extreme waves with an eye toward suspicious areas, such as the Bermuda Triangle, where rogues are thought to lurk. *—Michael Klesius*

What's New?

Quicksand, contrary to popular belief, won't completely swallow a human—even one who thrashes around. Researchers at the University of Amsterdam re-created a sample of quicksand found in northern Iran and added plastic beads that had the same density as human or animal bodies. No matter how much they shook the mixture, the beads remained only partly submerged.

Thirsty? Bottled water consumption jumped 57 percent between 1999 and 2004, according to an Earth Policy Institute report. The U.S. leads, with an average of eight ounces a person a day. Next is Mexico, followed by China and Brazil. Each year, consumers spend 100 billion dollars on the stuff. Meanwhile, 1.1 billion people lack a secure water supply, a problem the United Nations says will cost 30 billion dollars a year until 2015 to reduce by half.

PHOTO: KARSTEN PETERSEN. WAVE DATA: EUROPEAN SPACE AGENCY AND GERMAN AEROSPACE CENTER

It's a fine line between respecting your teen's privacy and doing your job as a parent.

How far should you go? As far as you have to. Because teenagers today have a minefield of risky behaviors to navigate—

drugs, drinking, tobacco, sex

—with powerful influences like peer pressure and mixed messages from pop culture, and new technologies such as the internet.

Fortunately, there's one influence in your teenager's life that trumps them all. You. So take action.

Let them know just where you stand on risk-taking and its consequences. And spell things out, because it's the contract both you and your teen will be living by. Set clear rules with your teen for safety and guidance. That's right, getting them to agree to the rules and understand the consequences gives them more responsibility and every teen wants that.

And yes, do keep close tabs on your teens. Know where they are and who they're with. Cell phones make it easier than ever to just "check in." It's not saying you don't trust your teen, it's saying you care. Get on the internet, too. Familiarize yourself with the kind of content they might be exposed to.

Above all else, one of the most powerful things you can do for your teenager is to set a good example when it comes to drug, tobacco and alcohol use. Respect them, be honest with them, be clear with them and they'll do the same. Everyone wins.

Signed,
American Academy of Child and Adolescent Psychiatry, American Academy of Family Physicians, American Academy of Pediatrics, American Legacy Foundation, American Lung Association, CTIA–The Wireless Association®, Cox Communications, Leadership to Keep Children Alcohol Free, National African American Tobacco Prevention Network, National Asian Pacific American Families Against Substance Abuse, National Cable and Telecommunications Association, National Campaign to Prevent Teen Pregnancy, National Families in Action, National Latino Children's Institute, Qwest Communications, and The Partnership for a Drug-Free America.

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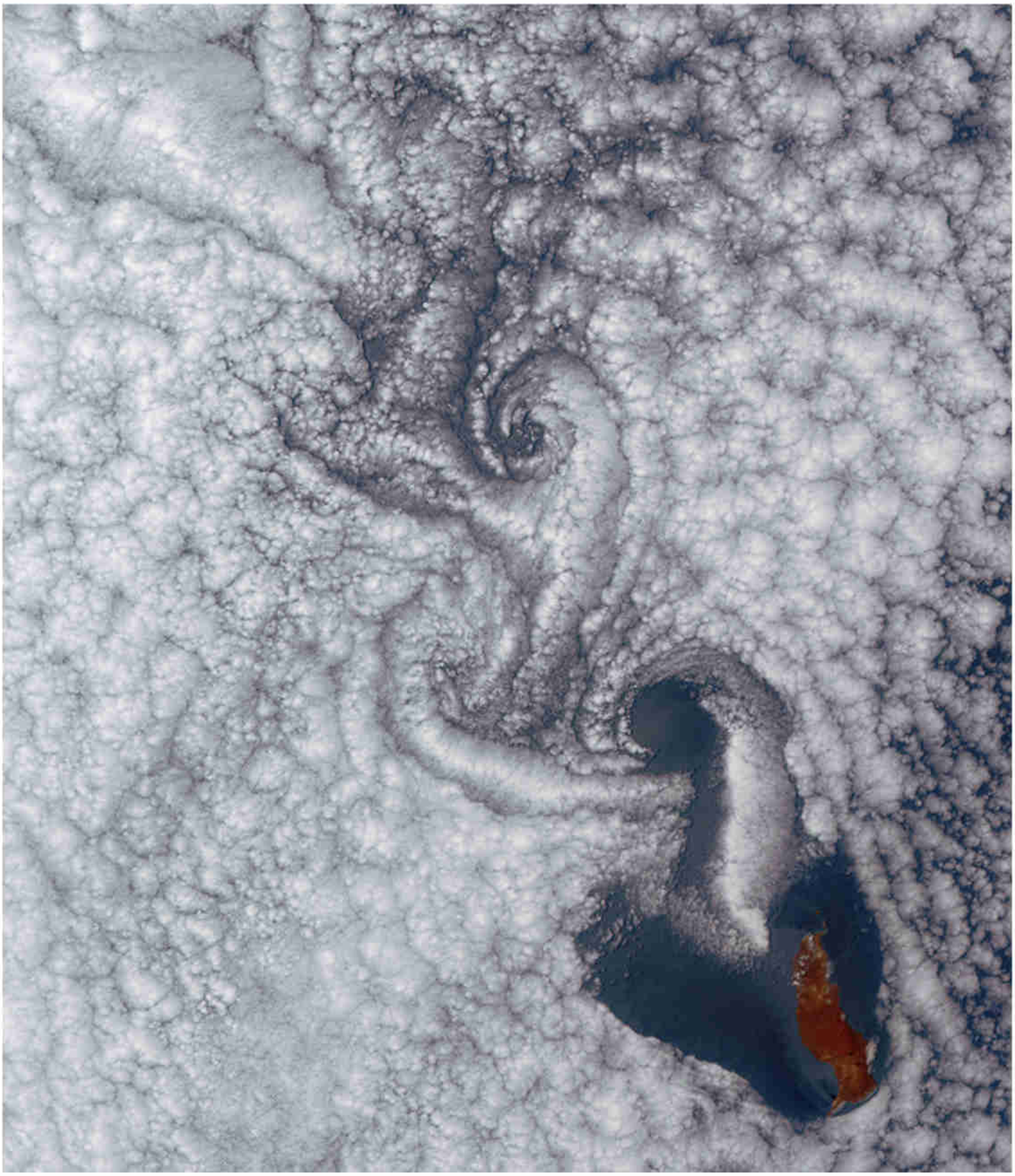
For more tips and support on parenting your teen, call 1-800-788-2800 or visit www.theantidrug.com

WHERE IN THE WORLD?



Guadalupe Island has been designated a biosphere reserve by the Mexican government.

A Question of Clouds Streaming formations known as von Karman vortices swirl in the cloud cover over Mexico's Guadalupe Island, some 160 miles west of Baja California. Guadalupe's volcanic peaks jut nearly a mile high, creating an obstacle to atmospheric airflow. Clouds above islands often blow into such patterns, says Ralph Kahn, senior research scientist at Caltech's Jet Propulsion Laboratory. "Take a stick and run it through standing water in your bathtub," he says, "or watch as muddy river water flows around an obstacle. It's the same idea." *—Simran Chawla*

PHOTO: NASA/GSFC/JPL, MISR TEAM

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Without the detail of lifelike surround sound, you miss the full experience movies and music have to offer. That's why the new Lifestyle® 48 DVD home entertainment system is engineered with unique Bose® technologies and designed to exceed your expectations.

For example, as you may have experienced, some rooms can make even the most expensive system sound like one worth half the price. Room size, shape and furnishings all affect the sound from any system. To address this problem, Bose has developed the **ADAPTiQ®** audio calibration system to bring more lifelike sound to almost any room.

The new Lifestyle® 48 system also features a redesigned **Acoustimass®** module that utilizes our proprietary technology. So you experience the impact of today's movie soundtracks from a compact unit that's 30% smaller than the original.

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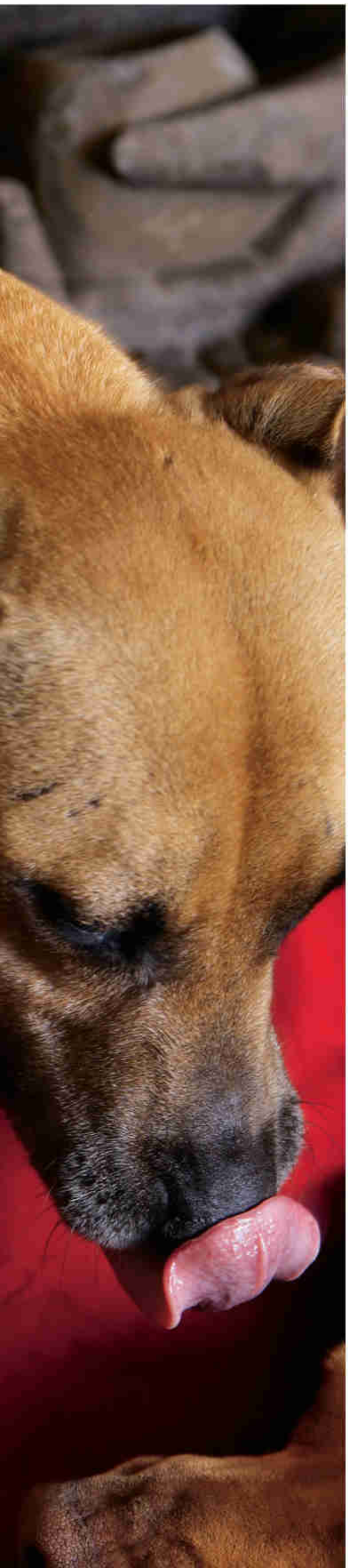
Leader of the pack: Cesar Millan and pit bulls Sam, top, and Spike. “I train people. I rehabilitate dogs,” Millan says.



Cesar Millan
The Dog Whisperer

INTERVIEW BY CATHY NEWMAN

Cesar Millan doesn't walk a dog. He leads a dog. He commands—with board-straight posture, a prime-time smile, and the confidence of a gladiator who knows he's the biggest (despite his short, compact frame), most dominant dude in the coliseum. Do not call Cesar a dog trainer. He is a dog rehabilitator. Propelled by his successful Dog Whisperer *show on the National Geographic Channel, he has leaped from dog trainer to dog rehabilitator to brand (Cesar Millan, Inc.) faster than a speeding greyhound. He is the dog guru for the Age of Indulgent Owners. Delinquent dogs—Nunu, the Chihuahua from hell; Brady, the Labrador who belly flops on family members in the pool—don't have behavior problems. They have issues. Born in Culiacán, Mexico, and smuggled across the border 16 years ago by a "coyote," Cesar now runs the Dog Psychology Center out of a chain-link-fenced two acres in a mangy neighborhood in south-central Los Angeles. The 30 or so dogs in his pack (used to rehabilitate dangerous dogs) are pit bulls, Rottweilers, German shepherds—whatever comes in. Clients include Oprah Winfrey ("I was telling her, this woman who . . . ranks as the most powerful celebrity . . . that she was not being a leader to her 20-pound cocker spaniel") and fat-cat billionaires, one of whom whisked his two dogs (incompatibility issues) in separate trips by private jet across the country for consultation. These days Cesar sees few private clients. Instead, he travels around the country holding seminars. Inspired by Lassie and Rin Tin Tin, Cesar had a dream—to make it not in Shreveport, Omaha, or New York, but in Hollywood. He has.*

Can you teach an old dog new tricks?

I do that all the time. Any dog can be rehabilitated. They can be 10, 11, 12, 13—as long as the mind is young.

What is the biggest mistake we make with dogs?

We humanize dogs. We hold conversations with them as if they were people. We use dogs for our own emotional yearnings. A dog doesn't know it lives in Beverly Hills or how much we spend on it. In Mexico, Petco would never make the same amount of money. I use a 35-cent leash—a piece of cord. It's all about us. Animals need to work for food and water. The ones who get food and water just because they are cute—those are my clients.

MARK THIESSEN, NATIONAL GEOGRAPHIC PHOTOGRAPHER

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Millan calms Louis, a Chinese crested. From a dog point of view, Millan says, Americans have got it wrong. The dogma should be exercise, discipline, affection—not affection, affection, affection.

What about the idea of a dog as accessory, like a handbag or pair of sunglasses?

Accessories and decoration are part of our history. They tell people who you are—like a bone in the nose or tattoo or paint on your face or wearing feathers because it makes you look better. There is nothing wrong with making a dog an accessory. We can't take that away. But we can take away from the dog that he is a dog.

Why do people gravitate to particular breeds?

It's about what they want from another human but can't get, so they get it from a dog.

So you'd get a pit bull, because . . . ?

Because it represents power, strength, masculinity—like driving a Ferrari. Or a Hummer.

And a small fluffy poodle?

Because it's feminine. Decorative.

So, we wear ourselves at the end of our leads?

I walk into a home and don't have to hear much. I see the dog, and I know who you are. It is a mirror.

It sounds like your approach to correcting dog problems is about correcting owner problems and training them to lead their dogs, not the other way around.

If you don't tell a dog what to do, it will tell you what to do. My clients are powerful, they have Harvard degrees, they run Fox Studios, Oxygen, Disney, they run the world, but they can't control a dog. You don't ask a dog if it would like to go for a walk. You put on the leash and go. A dog is first an animal, then a dog, then a breed, and then its name.

How does someone like Oprah, who presumably knows how to be a pack leader, fall apart when it comes to owning a dog?

Because the goal changes. It's not, What can I do for Sophie [her cocker spaniel]? as much as, What can Sophie do for me? Sophie fills the empty space. It is the wrong way to begin a relationship. Unconditional love isn't enough to control a dog. Dogs don't follow an emotional leader. They follow the dominant leader. We are the only species that follows an unstable leader.

What about Presidents and their dogs?

When you see the President of the United States coming out of *Air Force One*, you always see the dog in front. When you see the President going inside the White House, you see the dog going inside first. Bill Clinton couldn't control his Labrador. Nancy Reagan had to exile her Bouvier to the Reagans' California ranch. You can't let a powerful breed take the lead. If you did that with a pit bull, there would be no Presidents to meet with.

You work with phobic dogs, like the Great Dane that wouldn't

PHOTO: MARK THIESSEN

If it's always time to go, it may be time to talk with your doctor.

Frequent trips to the bathroom may be a symptom of benign prostatic hyperplasia (BPH), also known as enlarged prostate, a common and manageable condition that affects many men over age 50.

Uroxatral®
alfuzosin HCl 10 mg
Extended-Release Tablets

Indicated to treat the signs and symptoms of BPH.

Important safety information: Do not take UROXATRAL if you have liver problems or if you are taking the antifungal drugs ketoconazole or itraconazole or HIV drugs like ritonavir. The most common side effects with UROXATRAL are dizziness, upper respiratory tract infection, headache, and tiredness. UROXATRAL can cause a sudden drop in blood pressure, especially when starting treatment. This may lead to fainting, dizziness, and lightheadedness. Do not drive, operate machinery, or do any dangerous activity until you know how UROXATRAL will affect you. This is especially important if you already have a problem with low blood pressure or take medicines to treat high blood pressure. Before taking UROXATRAL, tell your doctor if you have kidney problems. Also, tell your doctor if you or any family member(s) have or take medications for a rare heart condition known as congenital prolongation of the QT interval. BPH is not cancerous and does not lead to cancer, but men can have both BPH and prostate cancer.

sanofi aventis

Please see patient information on back.

www.uroxatral.com

Patient Information

UROXATRAL®
(Alfuzosin hydrochloride extended-release tablets)

Read the Patient Information that comes with UROXATRAL before you start using it and each time you get a refill. There may be new information. This leaflet does not take the place of talking with your doctor about your condition or your treatment. You and your doctor should talk about all your medicines, including UROXATRAL, now and at your regular checkups.

What is the most important information I should know about UROXATRAL?

UROXATRAL can cause:

- **a sudden drop in blood pressure, especially when you start treatment. This may lead to fainting, dizziness, or lightheadedness. Do not drive, operate machinery, or do any dangerous activities until you know how UROXATRAL affects you. This is especially important if you already have a problem with low blood pressure or take medicines to treat high blood pressure. If you begin to feel dizzy or lightheaded, lie down with your legs and feet up, and if your symptoms do not improve call your doctor.**

What is UROXATRAL?

UROXATRAL is a prescription medicine that is called an "alpha-blocker". UROXATRAL is used in adult men to treat the symptoms of benign prostatic hyperplasia (BPH). UROXATRAL may help to relax the muscles in the prostate and the bladder which may lessen the symptoms of BPH and improve urine flow.

Before prescribing UROXATRAL, your doctor may examine your prostate gland and do a blood test called a prostate specific antigen (PSA) test to check for prostate cancer. Prostate cancer and BPH can cause the same symptoms. Prostate cancer needs a different treatment.

UROXATRAL is not for use in women or children.

Some medicines called "alpha-blockers" are used to treat high blood pressure. UROXATRAL has not been studied for the treatment of high blood pressure.

Who should not take UROXATRAL?

Do not take UROXATRAL if you:

- have liver problems
- are taking antifungal drugs like ketoconazole or HIV drugs called protease inhibitors
- are already taking an alpha-blocker for either high blood pressure or prostate problems
- are a woman
- are a child under the age of 18
- are allergic to UROXATRAL. The active ingredient is alfuzosin hydrochloride. See the end of this leaflet for a complete list of ingredients in UROXATRAL.

Before taking UROXATRAL, tell your doctor:

- if you have liver problems
- if you have kidney problems
- if you or any family members have a rare heart condition known as congenital prolongation of the QT interval.
- about all the medicines you take, including prescription and non-prescription medicines, vitamins and herbal supplements. Some of your other medicines may affect the way you respond or react to UROXATRAL.
- if you have had low blood pressure, especially after taking another medicine. Signs of low blood pressure are fainting, dizziness, and lightheadedness.
- if you have a heart problem called angina (pain in your chest, jaw, or arm).

What you need to know while taking UROXATRAL (alfuzosin HCl) tablets

- If you have an eye surgery for cataract (clouding of the eye) planned, tell your ophthalmologist that you are using UROXATRAL or have previously been treated with an alpha-blocker.

How do I take UROXATRAL?

- Take UROXATRAL exactly as your doctor prescribes it.
- Take one UROXATRAL tablet after the same meal each day. UROXATRAL should be taken just after eating food. Do not take it on an empty stomach.
- Swallow the UROXATRAL tablet whole. Do not crush, split, or chew UROXATRAL tablets.
- If you take too much UROXATRAL call your local poison control center or emergency room right away.

What are the possible side effects of UROXATRAL?

The most common side effects with UROXATRAL are:

- dizziness
- headache
- tiredness

Call your doctor if you get any side effect that bothers you.

These are not all the side effects of UROXATRAL. For more information ask your doctor or pharmacist.

How do I store UROXATRAL?

Store UROXATRAL between 59°F and 86°F (15°C and 30°C).

Protect from light and moisture.

Keep UROXATRAL and all medicines out of the reach of children.

General information about UROXATRAL:

Medicines are sometimes prescribed for conditions that are not mentioned in patient information leaflets. Do not use UROXATRAL for a condition for which it was not prescribed. Do not give UROXATRAL to other people, even if they have the same symptoms you have. It may harm them.

This leaflet summarizes the most important information about UROXATRAL. If you would like more information, talk with your doctor. You can ask your doctor or pharmacist for information about UROXATRAL that is written for health professionals.

You may also visit our website at www.UROXATRAL.com or call 1-800-446-6267.

What are the ingredients of UROXATRAL?

Active Ingredient: alfuzosin hydrochloride

Inactive Ingredients: colloidal silicon dioxide (NF), ethylcellulose (NF), hydrogenated castor oil (NF), hydroxypropyl methylcellulose (USP), magnesium stearate (NF), mannitol (USP), microcrystalline cellulose (NF), povidone (USP), and yellow ferric oxide (NF).

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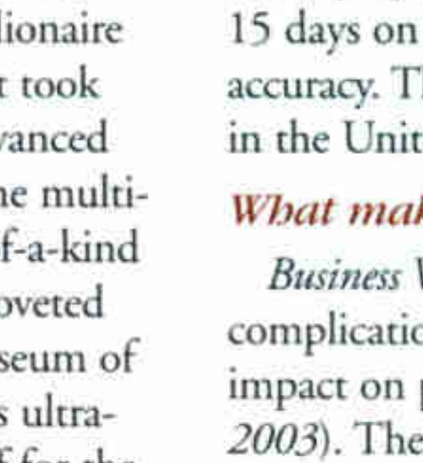
World's Most Valuable Timepiece Disappears

Back in 1933, the single most important watch ever built was engineered for a quiet millionaire collector named Henry Graves. It took over three years and the most advanced horological technique to create the multi-function masterpiece. This one-of-a-kind watch was to become the most coveted piece in the collection of the Museum of Time near Chicago. Recently this ultra-rare innovation was auctioned off for the record price of $11,030,000 by Sotheby's to a secretive anonymous collector. Now the watch is locked away in a private vault in an unknown location. We believe that a classic like this should be available to true watch aficionados, so Stauer replicated the exact Graves design in the limited edition Graves '33.

The antique enameled face and Bruguet hands are true to the original. But the real beauty of this watch is on the inside. We replicated an extremely complicated automatic movement with 27 jewels and seven hands. There are over 210 individual parts that are assembled entirely by hand and then tested for over 15 days on Swiss calibrators to ensure accuracy. The watches are then reinspected in the United States upon their arrival.



27 jewels and 210 hand-assembled parts drive this classic masterpiece.

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Business Week states it best…"It's the complications that can have the biggest impact on price." (*Business Week, July, 2003*). The four interior complications on our Graves™ watch display the month, day, date and the 24 hour clock graphically depicts the sun and the moon. The innovative engine for this timepiece is powered by the movement of the body as the automatic rotor winds the mainspring. It never needs batteries and never needs to be manually wound. The precision crafted gears are "lubricated" by 27 rubies that give the hands a smooth sweeping movement. And the watch is tough enough to stay water resistant to 5 atmospheres. The movement is covered by a 2-year warranty.

The face of the original 1930 s Graves timepiece from the Museum of Time.

Many fine 27-jewel automatics that are on the market today are usually priced well over $2,000 dollars, but you can enter the rarified world of fine watch collecting for under $100. Try the handsome Graves '33 timepiece risk free for 30 days. If you are not thrilled with the quality and rare design, please send it back for a full refund of the product purchase price.

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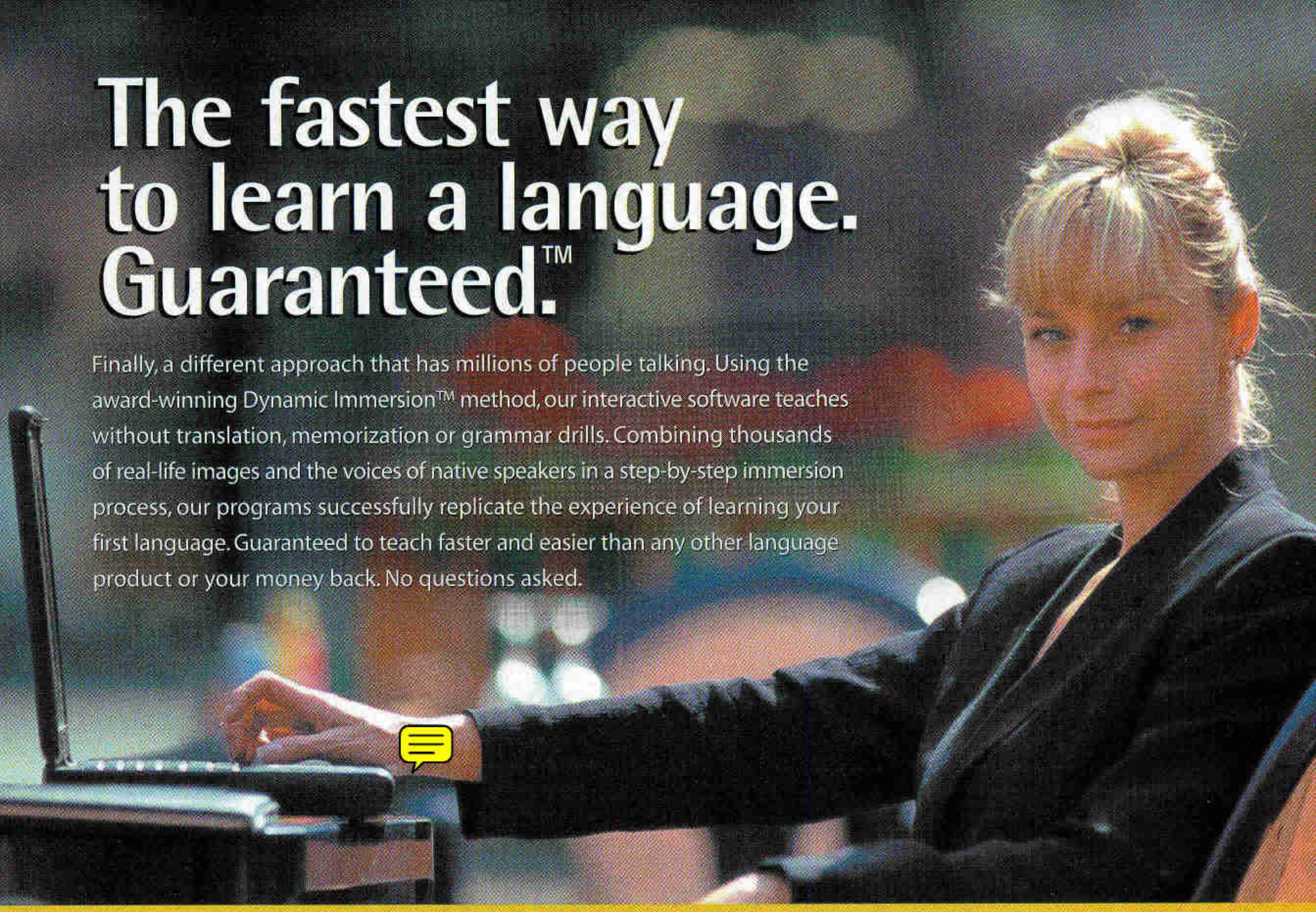

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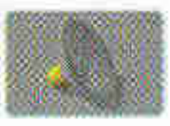

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If you don't tell a dog what to do, it will tell you what to do. A dog is first an animal, then a dog, then a breed, and then its name.

walk on shiny floors. Do you have any phobias?

My biggest fear is flying. But I do it.

Is there any creature you can't rehabilitate?

My father. My dad is in a red-zone state of mind. I want him to tell my mother, "I appreciate you. Thank you. I love you." But he can't, not in the machismo culture of Mexico.

Can't you just take your father for a walk and work out the issues?

No. He'd just run away.

How did your parents feel about your choice of profession?

They wanted me to become a professional. A doctor, lawyer, architect.

How does your father feel now that you've made it?

He still can't understand why Americans pay me for walking their dogs.

And your mother?

She would love me if I cleaned toilets. And, by the way, I did that, too, when I first came here.

Did any of your siblings fulfill their wishes?

My brother is studying to become an architect, and I am helping to pay for his education. Or the dogs are.

What are the lessons we learn from dogs?

To live in the moment. Also, honesty, loyalty, integrity. Dogs will never stab you in the back or lie to you.

So who is the better behaved animal—humans or dogs?

Oh, the dog.

Do dogs think and feel?

They feel—they are instinctual. They don't think, otherwise they would sue us. "Your honor, I haven't been walked for five years."

Does your approach work with other animals?

It works with anything that is pack-oriented—goats, horses, pigs.

Do you understand cats?

No.

Where do you want to take your message next?

We send our culture around the world, and the way we treat dogs is happening in Japan. It's a good thing I like sushi. After Japan, I can go to England.

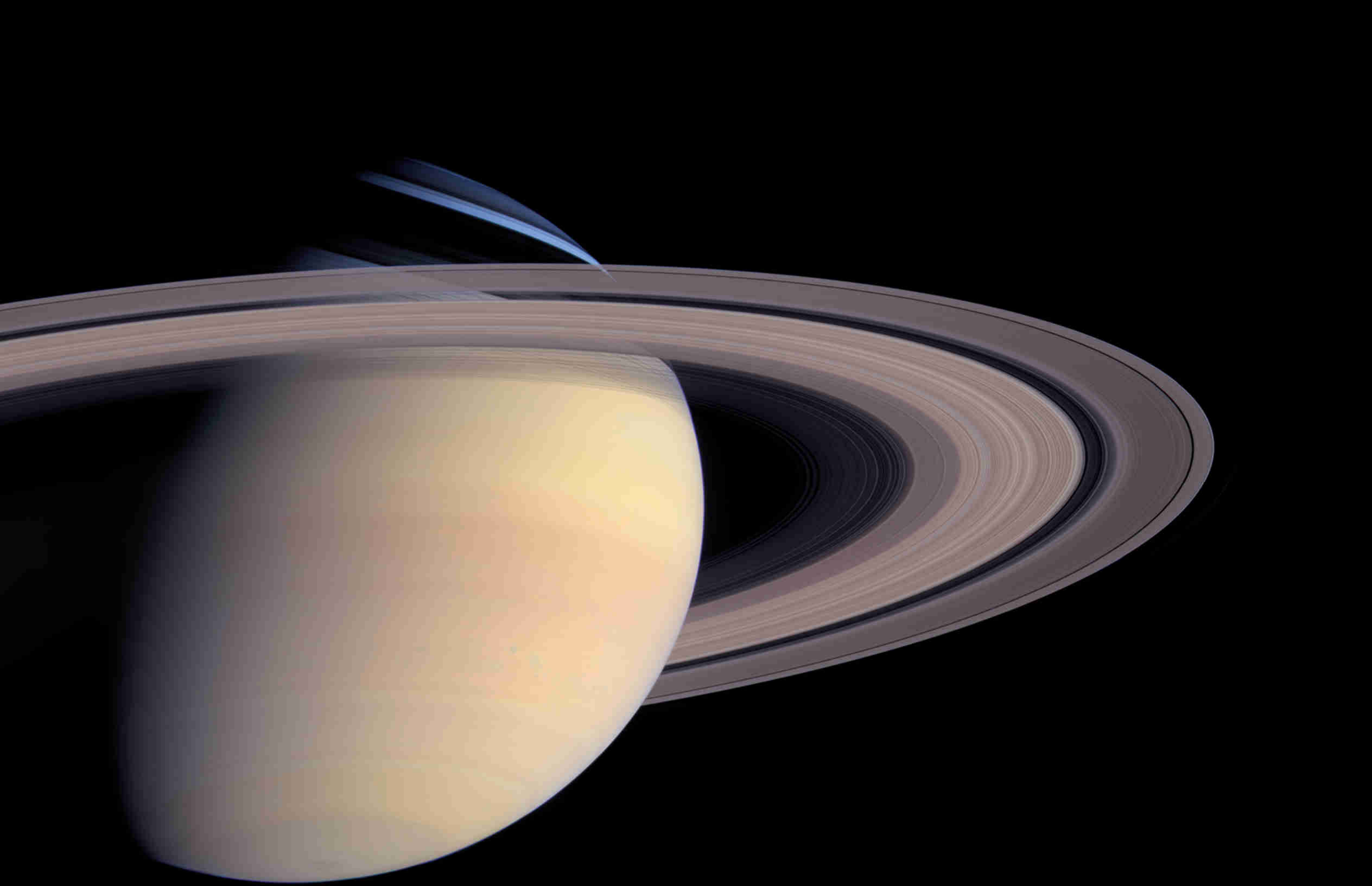
Given a choice, which would you rather have in your pack, Lassie or Rin Tin Tin?

Rin Tin Tin. A German shepherd is more like who I am—competitive, territorial, and dominant. □

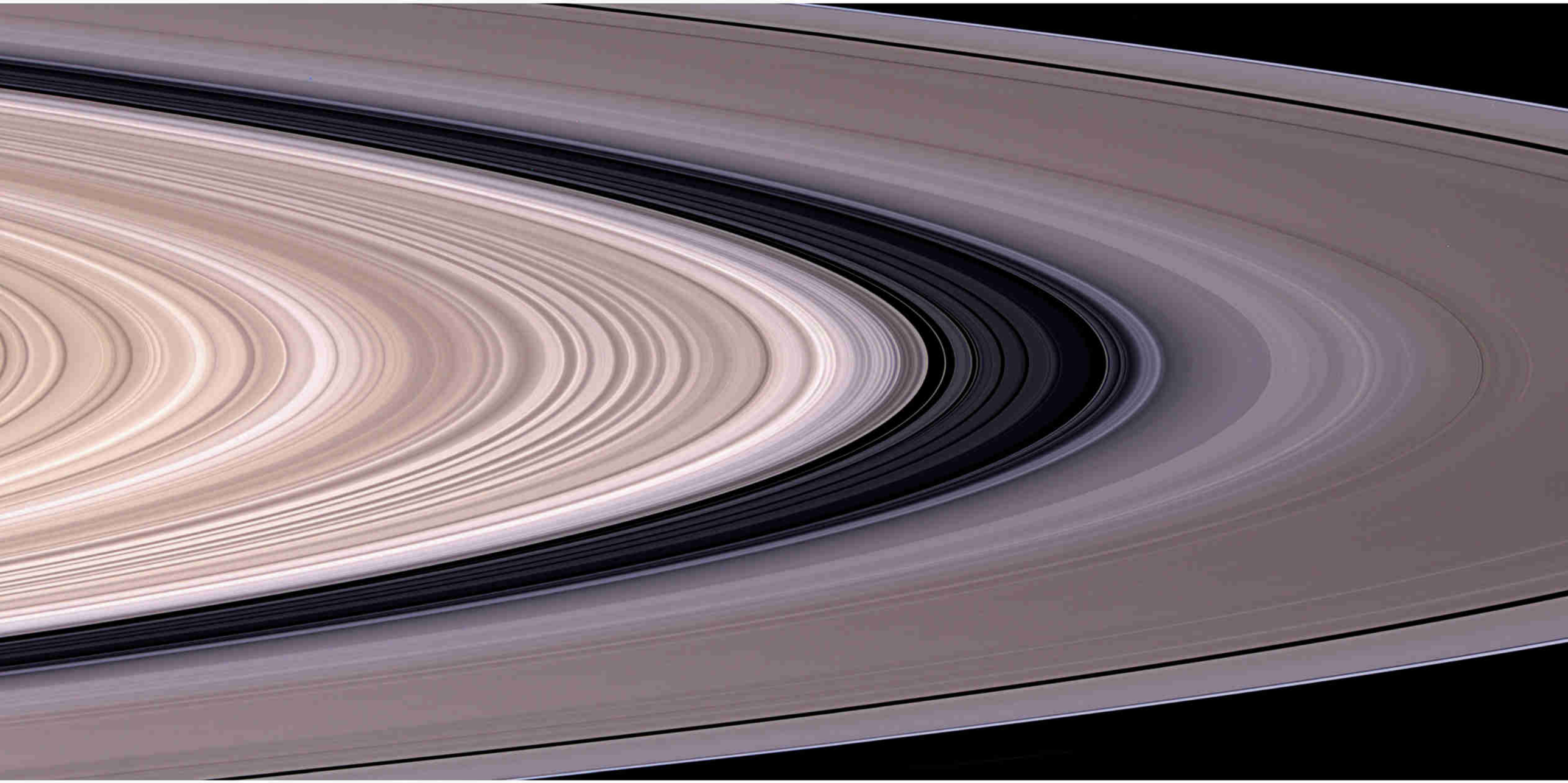
BEAUTIFUL STRANGER

SATURN'S MYSTERIES COME TO LIGHT

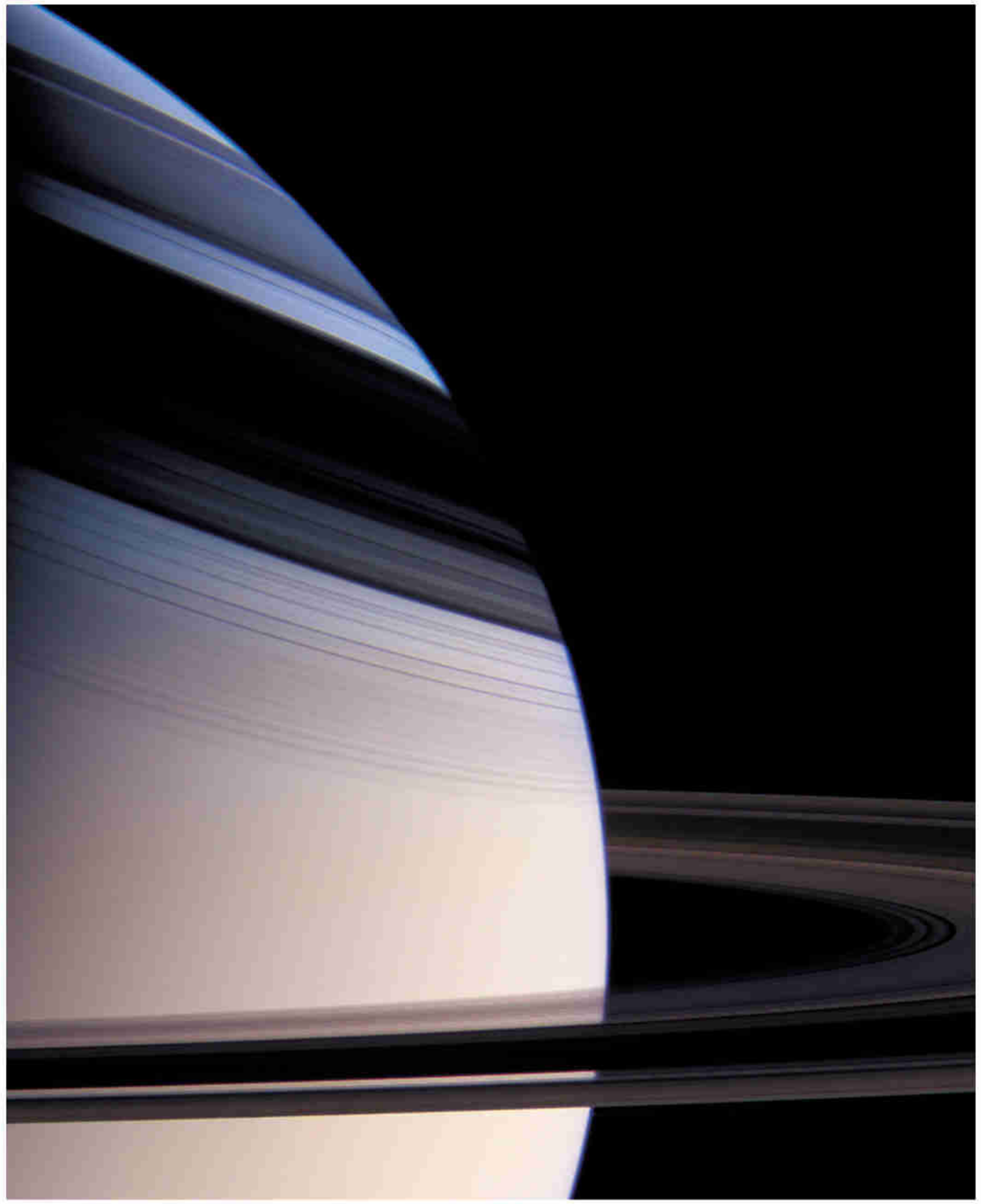
Four million miles from Saturn in late 2004, the Cassini spacecraft snapped a series of 126 natural-color photographs, stitched seamlessly to produce this montage—the most detailed portrait of the planet ever made. Cassini, which began its voyage in 1997, is one of the most ambitious missions to another planet.



Made of billions of ice particles, Saturn's rings average just 150 feet thick. Since their birth hundreds of

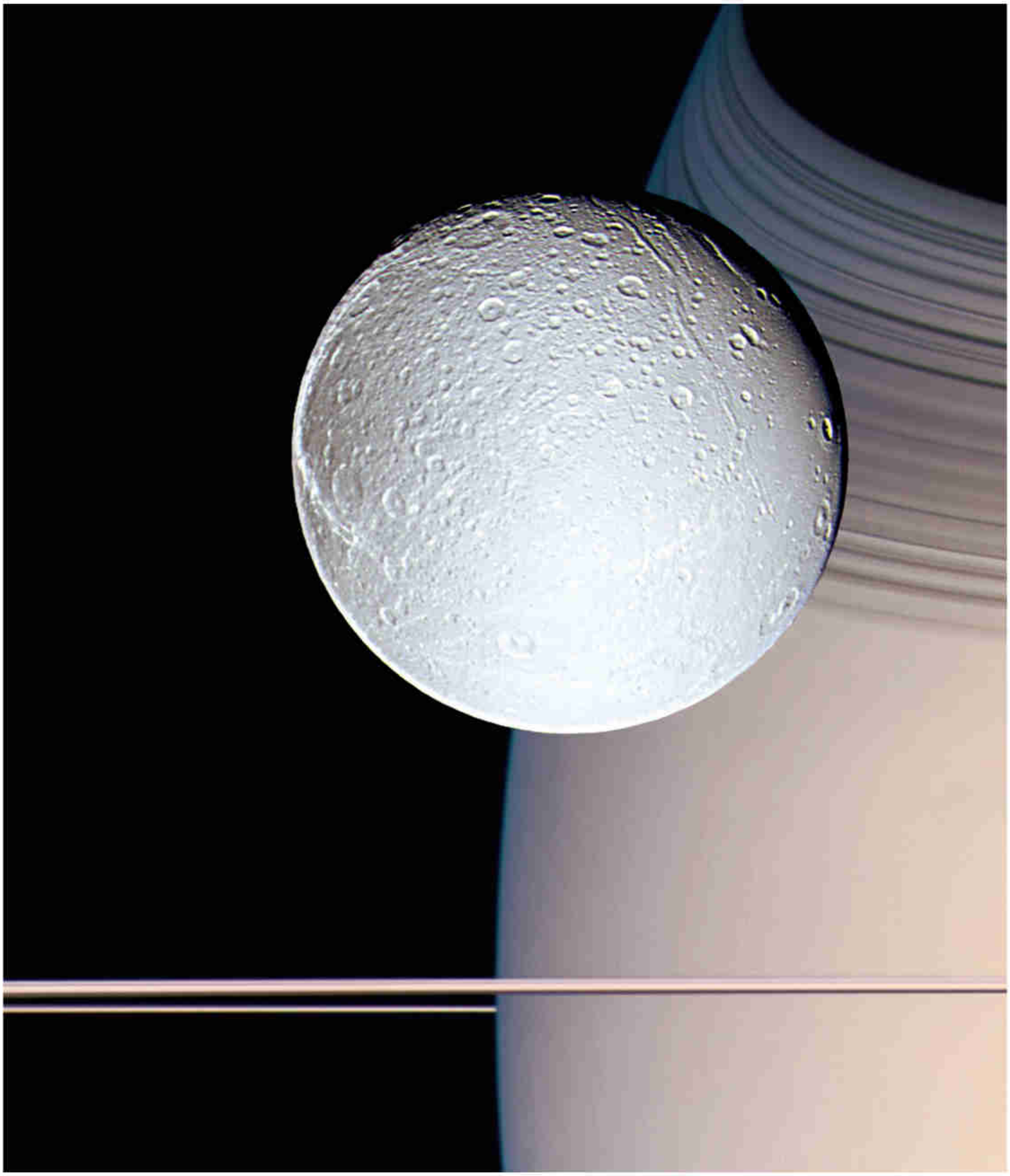


millions of years ago, perhaps from a shattered moon or comet, dust has dimmed them to delicate pastel shades.



Saturn's rings tattoo shadows onto the planet's tranquil cloud tops.

The moon Mimas is a minuscule silhouette against the planet at twilight.



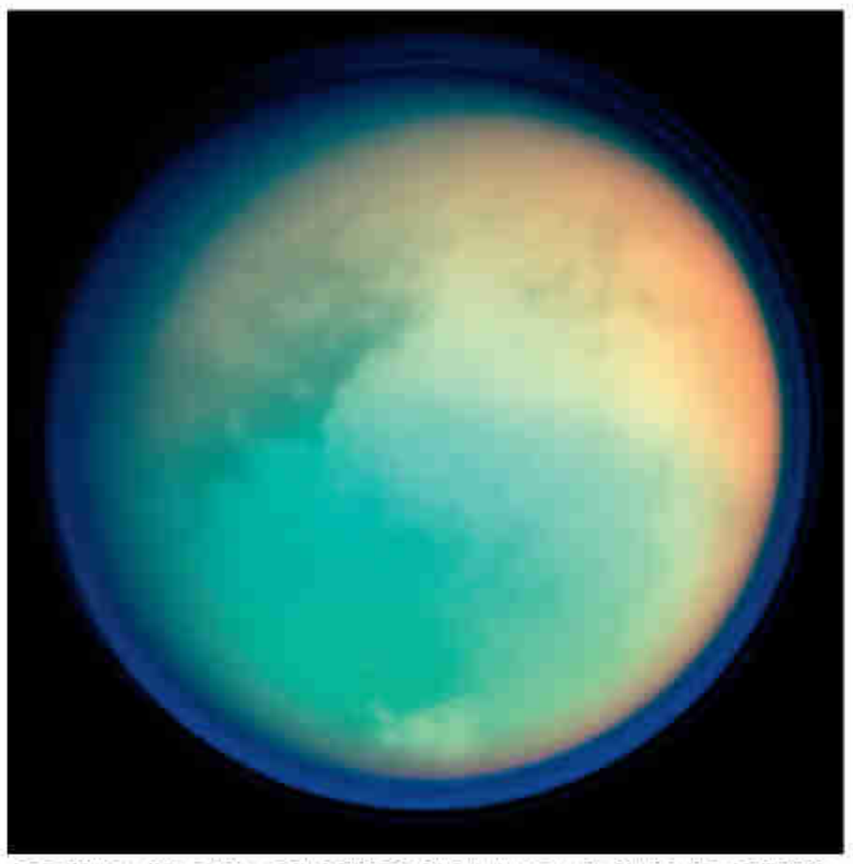
The icy moon Dione appears to hover above Saturn's rings, seen edge-on.

by BILL DOUTHITT
NATIONAL GEOGRAPHIC STAFF

images by NASA, JPL, *and* SPACE SCIENCE INSTITUTE

The rain comes just once every thousand years, in torrents of liquid methane. The noxious air dims sunshine to an eternal orange twilight. The cold—290 degrees below zero Fahrenheit—is a lethal assault. And beyond the hazy sky looms the ringed planet Saturn.

Yet here on Saturn's outsize moon Titan is a world eerily like our own. "Titan is a Peter Pan world," says Tobias Owen of the University of Hawaii's Institute for Astronomy. "It's got all the materials and elements to develop into a planet like Earth," he says, "but it never had the chance to grow up." The dense atmosphere is filled with hydrocarbon smog, "like L.A. on a bad day," Owen says. The rare methane monsoons create sudden rivers that cut deep channels in Titan's low hills and run down to a great sandy plain. Like Earth, Titan may have geologic activity and volcanism—a slow, chilly version that erupts a lavalike mix of half-melted water and ammonia. Most tantalizing of all, Titan's gentle winds carry a rich brew of organic molecules, some reminiscent of compounds that provided the raw material for life on Earth.



SATURN'S MOON TITAN, COLORED TO SHOW HAZE AND SURFACE FEATURES; CASSINI PROBE (OPPOSITE)

Owen and his fellow planetary scientists are used to picturing Titan in their imaginations. Now they've visited, if only by remote control. For the past two-and-a-half years, a space probe called Cassini has hobnobbed with the moons and rings of Saturn and gazed down on the giant planet. Soon after arriving, Cassini even launched a second, smaller probe called Huygens, which touched down on Titan's surface.

The Titan encounter was a high point in what has amounted to a voyage back in time. From the exotic metallic hydrogen in its interior to the fine rubble of its rings,

on moons that range from the icy oddball Phoebe to Enceladus, which spurts warm geysers, Saturn carries clues to how the solar system took shape 4.6 billion years ago and gave rise to life. The planet and its orbiting retinue, says planetary scientist Jeff Cuzzi of NASA's Ames Research Center, "connects us to solar system structure and evolution on the grandest scale."

Saturn has been slow to give up its secrets. In 1610 Galileo discovered what turned out to be its most amazing feature, the rings, but through his primitive telescope, he mistook them for two smaller bodies flanking Saturn. Only in 1656 did Dutch astronomer Christiaan Huygens (the namesake of the Titan probe) recognize what they were. Huygens also discerned a faint spark outside the rings—a moon later named Titan, after the Titans of Greek mythology, who reigned during Earth's early days.

Since then, decade by decade, astronomers have picked out smaller moons, 56 at last count. In the 1940s, as telescopes improved, they discerned a haze around Titan, the first sign that, unlike any other moon in the solar system, it has a dense atmosphere. Finally, the first space probes flew past Saturn—Pioneer 11 in 1979 and Voyagers 1 and 2 in 1980 and 1981. Speeding by, they snapped close-ups of the planet, rings, and moons and gleaned the first hints that Titan is a frozen time capsule of conditions similar to those found on the very early Earth.

Now, after centuries of curiosity and anticipation, scientists are taking a long, close look at Saturn. A metal cylinder 22 feet tall, bristling with scientific instruments and topped by a white saucerlike antenna, Cassini-Huygens was built by NASA, the European Space Agency, and the Italian Space Agency. It rocketed toward Saturn in 1997 and arrived on June 30, 2004, to begin at least four years of exploration.

As it neared the end of its 2.2-billion-mile journey, Cassini had to shed speed so that Saturn's gravity could capture it. The spacecraft fired its engines and dropped to within 13,000 miles of the planet's butterscotch clouds, making a daring passage between the outer rings. "White-knuckle time," Cassini project manager Robert Mitchell recalls.

The rings look crisp and manicured, but they are actually swarms of debris: billions of particles from mite- to mansion-size. A single stray pebble slamming into Cassini as it sped through the rings at over 68,000 miles an hour could have ended the 3.4-billion-dollar mission. Mitchell's team at NASA's Jet Propulsion Laboratory in Pasadena, California, anxiously monitored signals until Cassini, intact, settled into orbit and began to look around.

Exceeded in size only by Jupiter, Saturn could hold more than 700 Earths. Yet the planet, made almost entirely of hydrogen, is lighter than water. Dropped into an ocean big enough to contain its 75,000-mile diameter, it would float, bobbing like a colossal yellow sponge ball. It spins so fast that it bulges to a diameter 7,300 miles greater at the equator than at the poles, so fast that a Saturn day lasts less than 11 hours.

Because Saturn is mostly gas, it has no fixed landmarks to reveal its exact rotation rate. But its dense interior generates a powerful magnetic field that spins with the planet. Over the past two years, Cassini has clocked the field's rotation at 10 hours, 47 minutes, and 6 seconds, although no one is sure the planet itself spins at exactly the same rate. But the field also opens a window into the heart of Saturn.

Saturn began in the disk-shaped cloud of dust and gas that swirled around the newborn sun 4.6 billion years ago. Bit by bit, particles stuck together until gravity could take over, drawing material into ever larger lumps of iron and rock. One of them, perhaps several times the mass of Earth, was the seed that grew into Saturn.

DROPPED INTO AN OCEAN BIG ENOUGH TO CONTAIN ITS 75,000-MILE DIAMETER, SATURN WOULD FLOAT, BOBBING LIKE A COLOSSAL YELLOW SPONGE BALL.

Over time, the gravity of this rocky core attracted great clouds of hydrogen gas. The gas settled around the core, and the planet's mass rapidly grew. Pressures mounted, squeezing the innermost layer of hydrogen so hard that scientists believe it turned into a liquid metal—a superb electrical conductor. Currents surging through the metallic hydrogen generate Saturn's immense magnetic field.

More than four billion years later the core still retains heat from its formation, which stirs massive updrafts in the planet's deep atmosphere. They whip up supersonic winds, among the fastest in the solar system at up to a thousand miles an hour, and drive vast weather systems. "We see storms, lightning, zones of clouds, and strange wavelike features in the atmosphere," says Kevin Baines of NASA's Jet Propulsion Laboratory. In images from Cassini's infrared camera, the heat rising from deep in the atmosphere sets the planet aglow. "We're seeing backlit clouds," Baines says. "We can watch the weather day and night. It's a revelation."

Only at the very top of Saturn's atmosphere, capped by a yellowish layer of haze, does the turmoil subside. Here, on calmer clouds, the distant sun inscribes shifting patterns of shadows cast by Saturn's vast system of rings.

From edge to edge, the main rings span some 165,000 miles, over two-thirds the distance from Earth to the moon. Yet the thickness of these bands of icy rubble averages only 150 feet. "Think of a sheet of paper spread over ten football fields," says Cuzzi, who studies the rings.

No one knows how the rings formed, although some scientists speculate that Saturn's gravity tore apart an icy moon or a comet, strewing debris that provided the raw material. Whatever their source, the rings are recent, cosmically speaking. If they had existed for the life of the solar system, Cuzzi says, their subtle pinks, yellows, and tans—the result of dust buildup—would have darkened. But they offer a model for something ancient: the disk of particles orbiting the young sun and its interplay with the newborn planets.

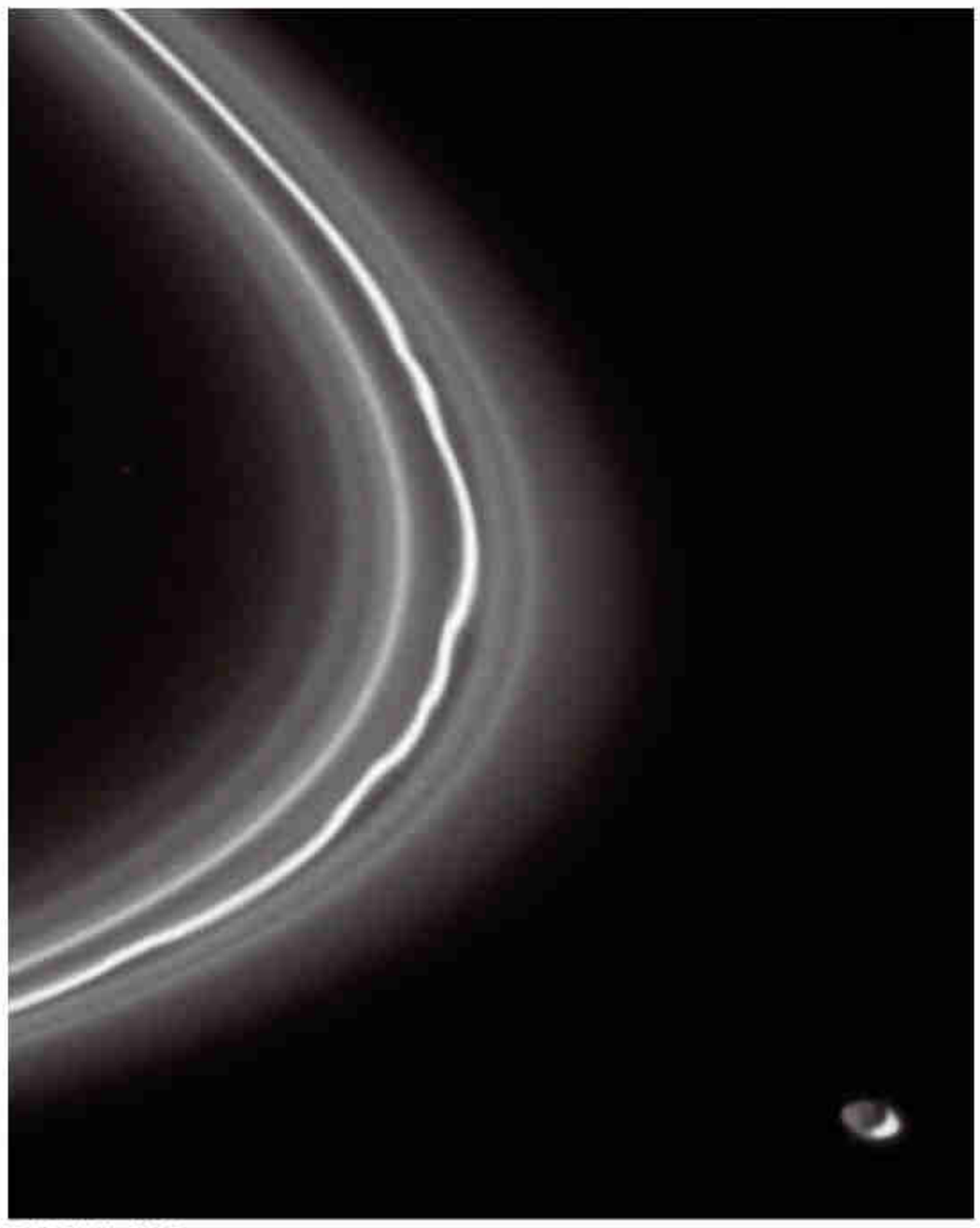
In Saturn's rings today, tiny moons play the role of the planets. Each moon's gravitational tug is minute, Cuzzi says, "about the same effect as a passing truck's gravity has on you." Yet the moons' gravity helps maintain the rings by keeping the particles from straying from their orbits. A moon can also carve a gap between rings, and its gravity can send waves of density rippling through a nearby ring, like traffic speeding and slowing on a crowded freeway.

The Voyager probes glimpsed this dance, but Cassini is adding new detail. During its dash through the rings in June 2004, for example, it spotted evidence of miniature moons in the gauzy A ring, the outermost of the main rings. These moonlets—likely to number in the millions—are only a few hundred yards in diameter, but their feeble gravity is enough to leave wakes in the ring. In the F ring, farther from the planet, Cassini imaged a skein of narrow ringlets, accompanied by moonlets that sweep material into clumps and then break them up again.

"We're seeing ringlets interacting with moons and moonlets sculpting rings," Cuzzi says—and gaining new insights into how solar systems develop. "It helps explain how planets form in protoplanetary disks." The tiny moonlets in the A ring spiral slowly inward as they churn the ring particles, in a process that could also have shaped some of the bizarre solar systems detected around other stars. There, Jupiter-size planets are found right next to their suns, in orbits closer than Mercury's—perhaps because of a similar migration process.

One relic of our own early solar system still orbits Saturn: the moon Phoebe. Phoebe revolves in the opposite direction from most of the other moons, a hint that it has an unusual history. Cassini took a close look on its approach

VOYAGER 1, 1980



CASSINI, 2005

The braided structure seen in Saturn's F ring by Voyager 1 (left) gave way to ripples in a Cassini image of the same ring 25 years later. The orbits of two nearby moons, Pandora (seen at right) and Prometheus, change over time, exerting a varying gravitational pull that reshapes the ring.

to Saturn in 2004 and found that the 130-mile-diameter moon is a hodgepodge of ice, rock, and carbon compounds—much like the Kuiper belt objects, small, icy bodies in the outer solar system that are thought to be leftover building blocks for the outer planets. As the solar system formed, most of the Kuiper belt worlds were flung far beyond Pluto. But Phoebe could be a Kuiper belt object that got left behind, trapped in orbit about the young Saturn.

Saturn's other major moons probably were born in the same clump of gas, dust, and rock that created the planet itself, but they are a study in diversity. Cassini revealed that some are little more than loose collections of rubble, including Hyperion, a potato-shaped mass 215 miles long. Larger moons are denser and have distinctive surface features, sculpted by accidents of history or by internal heat and the geologic activity it drives.

Images from Voyager, for example, showed that the 905-mile-diameter moon Iapetus is divided into black and white hemispheres, like a cosmic yin-yang symbol. Researchers suspect that the moon is made of nearly pure ice, which is exposed in the bright hemisphere and cloaked in rock and organic material on the dark side.

Cassini discovered new mysteries. Iapetus bulges in the middle, like Saturn, and has a ridge twice as high as the Himalaya running a thousand miles along the equator, mostly in the moon's dark hemisphere. "Nobody can figure this out," says Peter Thomas of Cornell University. "The bright and dark sides of Iapetus were one puzzle. That's moved back to third place with these new questions."

The most tantalizing of Saturn's moons is the largest: Titan. On December 25, 2004, six months after arriving at Saturn, Cassini launched the crown jewel of the mission, a saucer-shaped probe named Huygens that had ridden piggyback from Earth. Three weeks later, Huygens plunged into Titan's smoggy atmosphere.

At a gleaming white office complex of the European Space Operations Center in Darmstadt, Germany, hundreds of scientists, students, and journalists jammed an auditorium and waited for the first signals from Titan. A huge yellow model of Saturn dominated the front of the room, bright in the blaze of TV lights. Conversations in English, French, German, Spanish, and

NASA/JPL/CALTECH (LEFT)

Pan

Pandora
and Prometheus

Epimetheus
and Janus

Mimas

Other moons
are in E ring
and beyond.

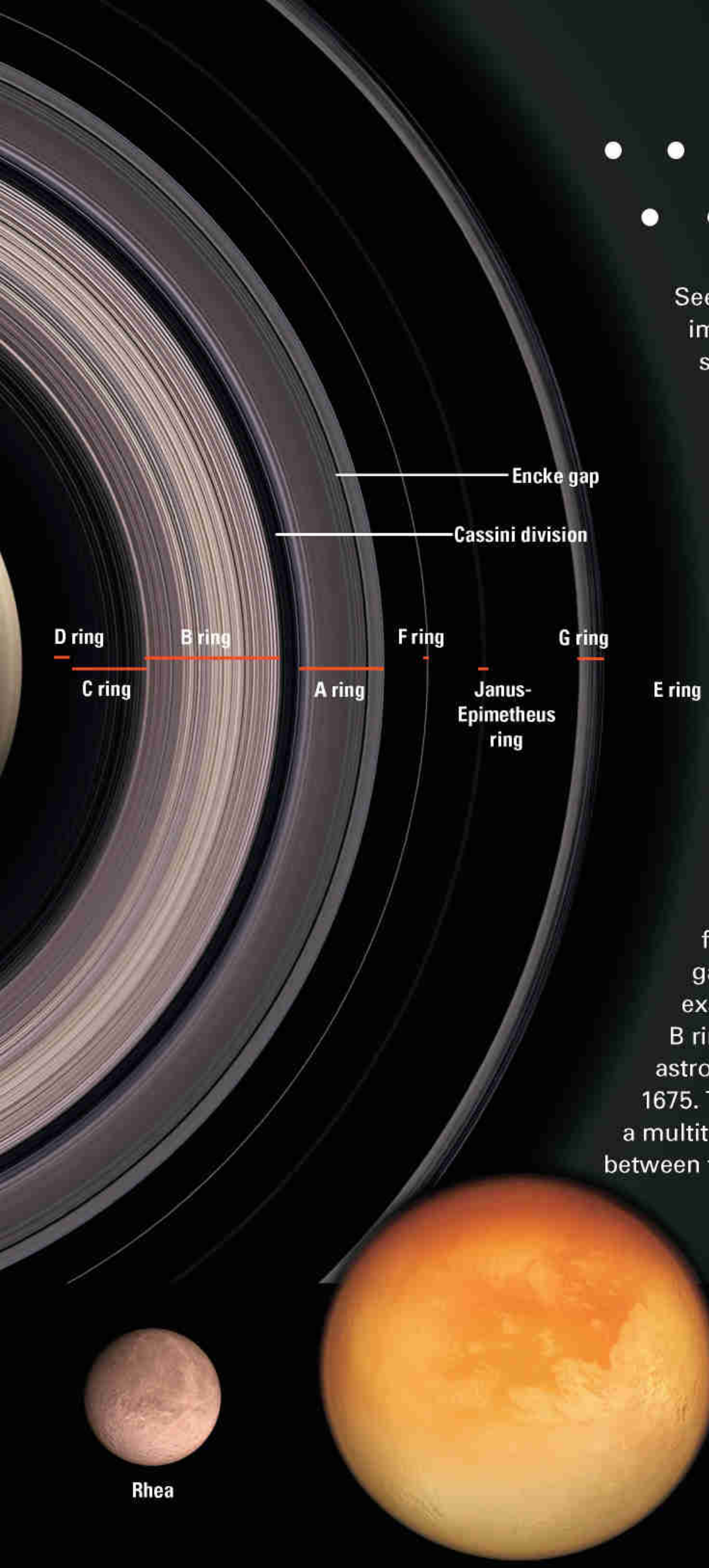
NOT TO SCALE

Pan | Prometheus, Pandora (right) | Janus (left), Epimetheus | Mimas | Enceladus | Tethys | Dione

MOONS ON PARADE

Saturn's 35 named moons range from objects a few miles across to giant **Titan,** larger than Mercury. Icy bodies with rock, methane, ammonia, and carbon dioxide, some of the moons may have formed when Saturn did. Others may be fragments of larger bodies, perhaps torn apart by collisions. And some, like **Phoebe,** may be interlopers captured from elsewhere in the early solar system.

Pan, the innermost known moon, created the Encke gap by clearing debris. **Prometheus** and **Pandora,** small, cratered lumps of ice and rock, roil the fast-changing F ring. **Janus** and **Epimetheus** shed dust



Seen from above its north pole in an artist's impression, Saturn resembles a miniature solar system, with rings spanning 165,000 miles (out to the A ring) and 56 known moons out to more than 10 million miles from the planet. A sampling of moons is shown below in the order of their distance.

Saturn is the sixth planet from the sun, 890 million miles out, and the second biggest, after Jupiter. Beneath its deep atmosphere is a layer of metallic hydrogen, wrapping a core of rock and ice. Its clouds look deceptively serene, masking thousand-mile-an-hour winds.

The rings, designated alphabetically in the order of their discovery, offer clues to how planets form in the disks of debris around young stars. The major rings contain thousands of smaller rings, some harboring small moonlets that help keep the ring particles from dispersing. Other moons help maintain gaps in the rings; the gravity of Mimas, for example, keeps particles from straying out of the B ring and into the Cassini division, which French astronomer Jean-Dominique Cassini discovered in 1675. The spacecraft that bears his name has found a multitude of new moonlets along with a new ring, between the F and G rings.

that fills a wispy, newly discovered ring. Ice-covered **Enceladus,** 310 miles in diameter, erupts plumes of water vapor and ice particles that smooth its surface and replenish the E ring. Their source may be subsurface pools of water. **Tethys, Dione,** and **Rhea** have thick coatings of heavily cratered water ice. **Titan** has a dense atmosphere, weather, erosion, and pools of liquid methane —an otherworldly echo of Earth. Irregularly shaped and battered, **Hyperion** may be the surviving remnant of a larger moon. **Iapetus,** perhaps the strangest moon, has one bright hemisphere and another that is a dull black.

ART BY DANA BERRY, SKYWORKS DIGITAL, BASED ON NASA IMAGES. CONSULTANTS: JOSEPH BURNS, CORNELL UNIVERSITY; JEFF CUZZI, NASA AMES; RALPH LORENZ, APPLIED PHYSICS LABORATORY; LARRY SODERBLOM, USGS; DAVID STEVENSON, CALTECH; AND PETER THOMAS, CORNELL UNIVERSITY

"THERE'S A LAYER OF FROZEN HYDROCARBONS, SIMILAR TO GASOLINE, COVERING MUCH OF THE MOON. IF YOU COULD MINE TITAN, YOU'D NEVER HAVE TO WORRY ABOUT OIL SHORTAGES."

—HUNTER WAITE, SOUTHWEST RESEARCH INSTITUTE

Italian flew around like stray meteoroids, reflecting the international origins of Huygens, which was also on display in a full-size mock-up.

The real thing, moving ten times faster than a rifle bullet, had slammed into Titan's outer atmosphere just an hour earlier. Pummeled by air friction, the probe's heat shield reached a temperature of thousands of degrees. Within minutes Huygens slowed and cooled. Parachutes opened, the heat shield dropped away, and Huygens drifted like a leaf on the winds of Titan, cameras and microphones recording the weather on a distant world.

"We'll be looking for lightning, but we might as well listen for thunder," said David Southwood, head of space science for the European Space Agency, who explained Huygens's progress to the crowded auditorium in Germany. "It's going to be very romantic," said Southwood, elegant in silver hair and a dark tweed suit.

As Huygens descended, people crowded into the big auditorium. Mission controllers were already receiving signals from Huygens, evidence that it had survived the descent. Relayed through Cassini, they took 67 minutes to travel from Saturn to Earth. Finally, at 5 p.m., Southwood took the podium and formally announced the probe's safe arrival. "We are the first visitors to Titan."

Now the wait began for the signals to be computer-processed into images. Hours dragged by. Suddenly a grainy black-and-white image appeared on televisions ringing the auditorium. Taken on the way down, it showed lumpy hills and a dark plain.

Crowds surged toward the televisions, and the moon named for the gods commanded a moment of ritualistic, almost worshipful media attention. TV crews filmed the image of Titan. Photographers snapped pictures of the TV crews filming. Radio reporters held microphones toward the commentary coming from the sets.

More images followed, including a hastily constructed mosaic showing a broad aerial panorama. Finally the first picture from the ground appeared. This was in color—a garish orange landscape, strewn with rocks. Low hills appeared in the distance. Long into the night, crowds clustered around the screens as they flashed the images, which had been transmitted hours before from Huygens to Cassini, stored on the mother ship, and then relayed to Earth.

By that time Huygens's short mission was already over. Cassini's orbit had carried it out of contact with the lander. Huygens continued to broadcast into the void for another two hours—far longer than expected—before its batteries went dead.

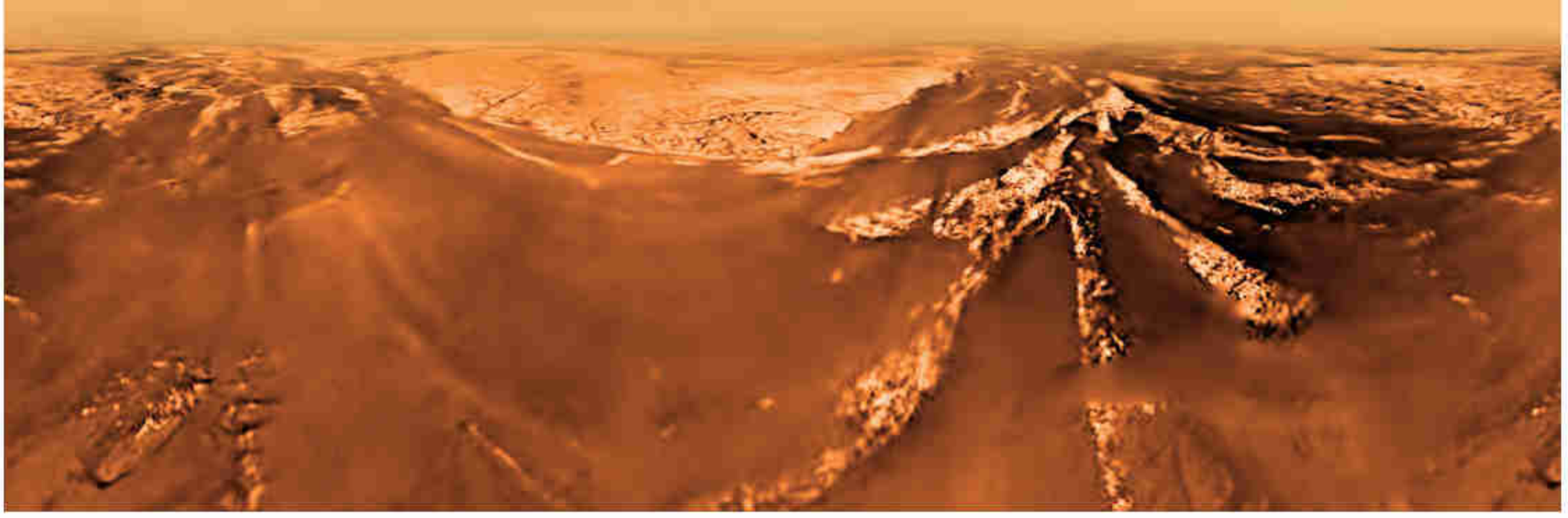
A glitch had marred the landing. Half the pictures—350 of them—were missing because of a communications failure. Even if everything had gone perfectly, Huygens could see only a small section of Titan, much like viewing an elephant at close range through a drinking straw. But it saw enough to answer some key questions.

Beforehand, no one knew whether Huygens would touch down on solid rock or squishy goo, or in an oily methane ocean. In fact the probe found no pools of liquid, but there were plenty of signs that the surface—crusty on top, soft below, like crème brûlée—is sometimes awash.

"We see signs of liquid methane scouring out river valleys," says Larry Soderblom of the USGS. "Titan may be like dry African deserts, but where rain only falls every century, or even every millennium. But when it comes, there may be a lot, like flash floods." The poles may be rainier. On a July flyby of the northern polar region, Cassini saw a landscape dappled with methane lakes—an otherworldly Minnesota.

The methane originates beneath Titan's crust, brewed in deep, warm reservoirs of water and organic material or trapped in icy deposits.

Deep Space Online Explore the solar system and Cassini's Saturn discoveries in an interactive Web feature at **ngm.com/0612**.



Escaping to the atmosphere, some of the methane falls back to the surface as rain while ultraviolet light transforms other methane molecules into more complex organic compounds, which fall as a toxic sleet. "Titan is the best organic factory in the solar system," says Hunter Waite of the Southwest Research Institute. "There's a layer of frozen hydrocarbons, similar to gasoline, covering much of the moon. If you could mine Titan, you'd never have to worry about oil shortages."

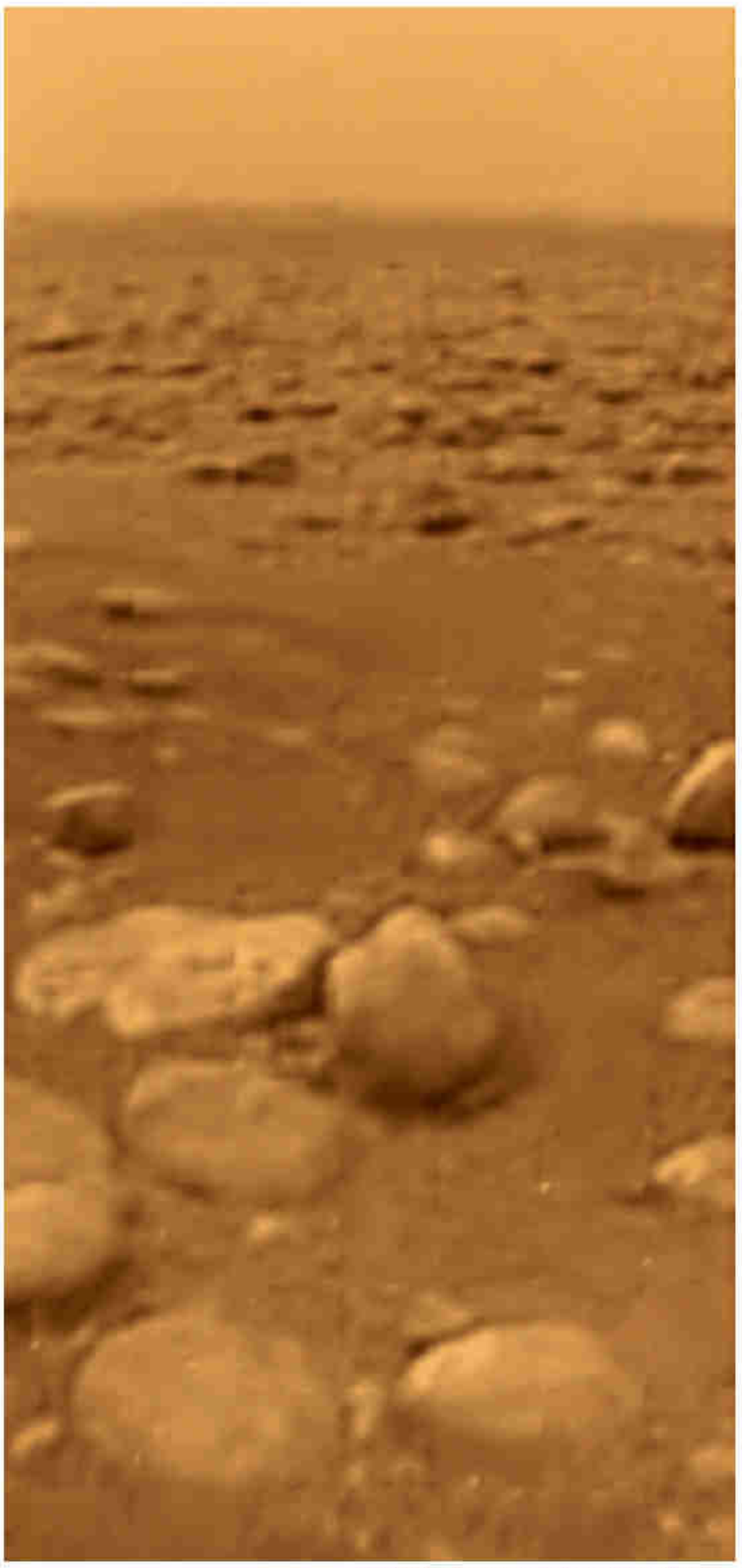
Over millions of years, Titan's winds sculpted this vast sea of hydrocarbon sand, sweeping it into dunes over 300 feet high that run in parallel rows for hundreds of miles. "Dead ringers for dunes in the Arabian desert," says Ralph Lorenz, a Titan expert at Johns Hopkins University's Applied Physics Laboratory.

Like our atmosphere, Titan's is largely made of nitrogen, which is a key component of life. So are complex carbon compounds like those in its smoggy air. Titan preserves some of the conditions needed to start life, though it is far too cold for the spark of life to ignite. But in Cassini's most surprising discovery so far, scientists stumbled on hints that another moon might actually be hospitable to simple life-forms.

Bright as a beacon, ice-covered Enceladus reflects more light than any other body in the solar system. A quarter of a century ago, Voyager images showed only a few large craters marring the moon's surface, leading scientists to suspect that geologic processes were somehow erasing the scars. Yet at only 310 miles across, Enceladus seemed too small to generate the heat needed to drive internal activity. In another puzzle, Enceladus seemed to be feeding material into the tenuous E ring, which is densest close to the moon.

Cassini swooped in to investigate. On two encounters early in 2005, it detected an odd disturbance of Saturn's magnetic field. Before the next encounter, Michele Dougherty of Imperial College London, chief of the magnetics team,

Descending through Titan's thick orange smog, the Huygens probe captured a 360-degree view (above). Seen from a mile up, bright ridges flank a highland that rises as much as 500 feet above a dark plain, perhaps a dried lake bed. Titan's surface (below) is dotted with cobblestone-size chunks of ice.

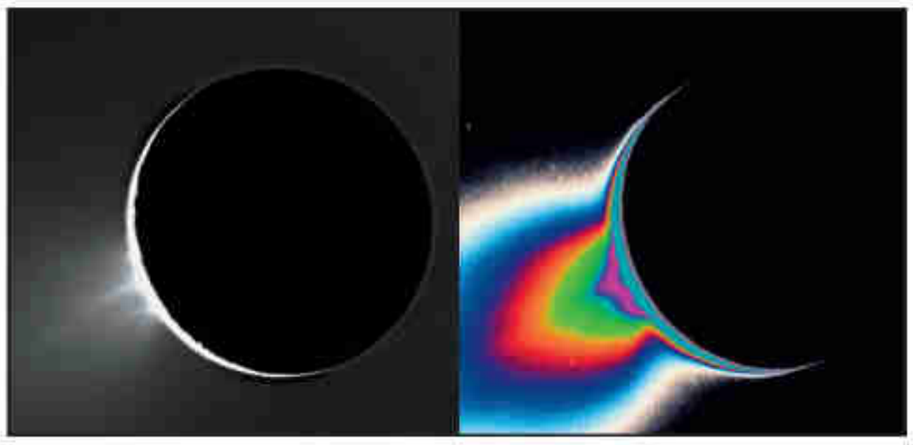


ESA/NASA/JPL/UNIVERSITY OF ARIZONA (BOTH)

"WE'RE LOOKING FOR PLACES WHERE WE MIGHT FIND BUGS. WE DON'T EXPECT ANYTHING INTELLIGENT, OR HIGHLY DEVELOPED, BUT HERE YOU HAVE A PLACE WHERE LIFE IS POSSIBLE."

—BOB BROWN, UNIVERSITY OF ARIZONA

pleaded with spacecraft controllers to set a course that would take Cassini close to the moon's south pole, where her team had measured the strongest disturbances.



On July 14, 2005, the spacecraft descended to a hundred miles above Enceladus's south polar region. Working in concert, its many instruments probed the enigmatic moon, monitoring surface heat, chemical traces, and magnetic fields. The data indicated that plumes of material were erupting near the south pole. Four months later, as the distant sun silhouetted Enceladus, Cassini made images that showed geyserlike eruptions of water vapor and ice particles shooting far into space.

The temperature near the south pole was at least 100 degrees F higher than expected—warm enough to melt ice just below the surface and feed the plumes, which erupt from long fissures that cut across the ice, dubbed "tiger stripes." In freshly fallen snow around the fissures, Cassini detected simple carbon compounds.

One mystery was solved. The E ring bulges near the moon because the plumes are pumping ice particles into it. Now a new puzzle arose: the source of the heat. It could be generated by radioactive elements trapped inside Enceladus or by Saturn's powerful gravity as it squeezes and flexes the moon.

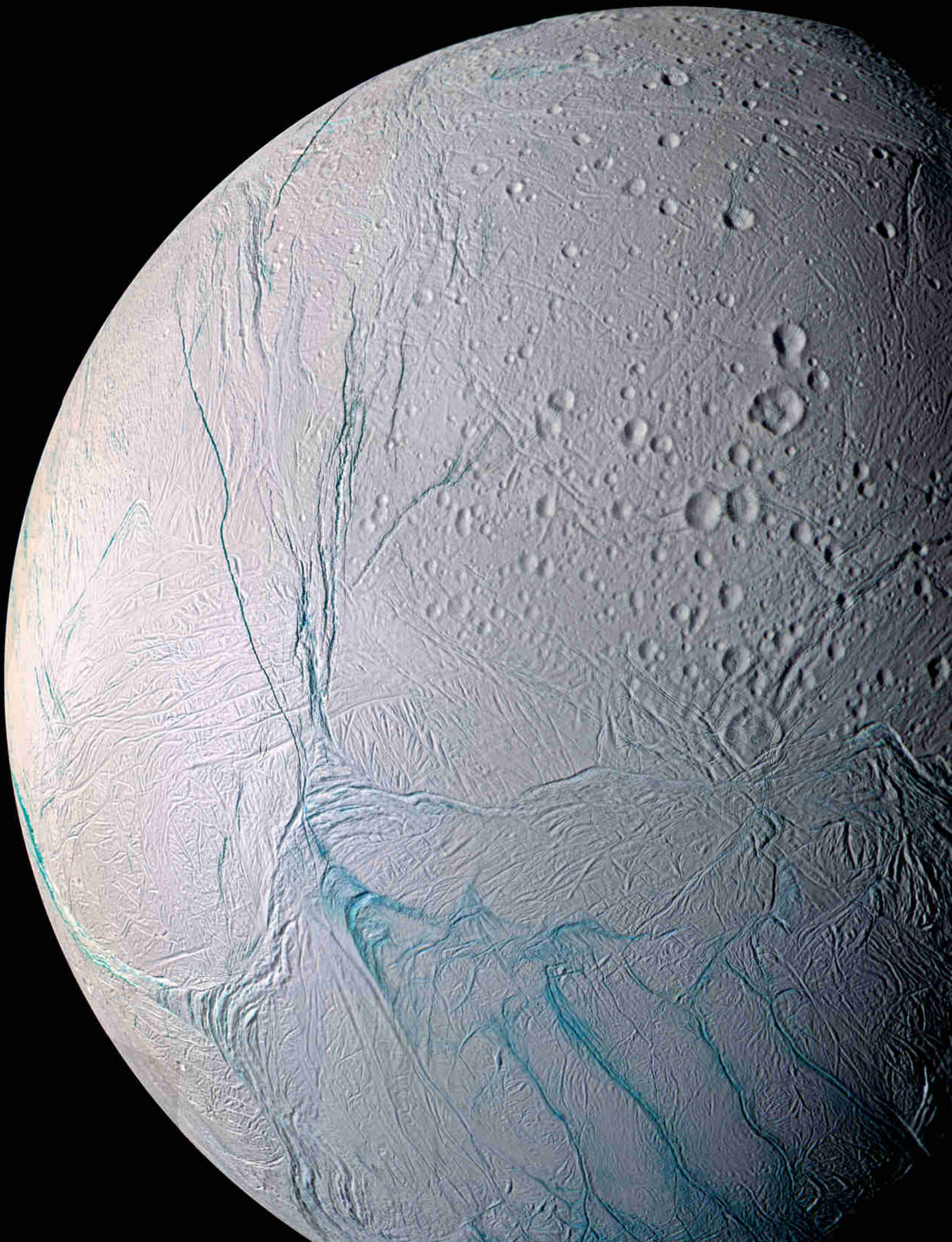
A greater question: Could this modest moon harbor life? Life as we know it requires liquid water, energy, and organic molecules, says Bob Brown of the University of Arizona. "Evidence of all three are here," he says. "We have the cocktail." That same cocktail, Brown says, may exist on Jupiter's moon Europa, in a briny ocean shielded under miles of ice. It may have existed long ago on Mars, when that planet was warm enough to harbor open water. It was present on Earth as early as 3.8 billion years ago. "But we know it exists right now on Enceladus."

Life might be hiding just a few dozen feet below the ice in pockets of warm water, living off dissolved organic compounds and reproducing using some alien version of DNA—or an entirely different kind of genetic material. "We're looking for places where we might find bugs," says Brown. "We don't expect anything intelligent, or highly developed, but here you have a place where life is possible."

Cassini is scheduled to revisit Enceladus once more and, if space budgets allow, may extend its mission beyond 2008 to make more flybys of Enceladus, Titan, and other key targets. But scientists are already thinking ahead to future space probes that could actually look for life on Enceladus and study the precursors of life on Titan—exploration that would take us closer to understanding our own origins.

Some dream of a robot that would land at the south pole of Enceladus and drop a probe through the vents to look for life. Others picture a satellite that would orbit Titan and launch blimp-like rovers into its atmosphere for a leisurely survey of its hills and plains. Jonathan Lunine of the University of Arizona, a Cassini-Huygens scientist who also studies planets around other stars, sees the quest in the biggest terms. "These places," he says, "will write new chapters in the book on how life began in the universe." □

Water vapor and ice particles erupt hundreds of miles from Enceladus (natural and false color, above). Falling to the surface, the ice smooths the moon's southern hemisphere (right). The jets emerge from fractures (false color) fed by subsurface reservoirs. Says Carolyn Porco, Cassini imaging team leader: "We have found an environment potentially suitable for living organisms."



EARTH
IN THE BEGINNING

Our planet began as an elemental place of rock and gases, where the sun was fainter than now and the moon—orbiting at less than a tenth of its current distance—looked immense. Hundreds of millions of years passed before the planet was fit for life. But here and there, scenes on today's very different Earth evoke its harsh beginnings.

YELLOWSTONE NATIONAL PARK

photo essay by FRANS LANTING

The early Earth was a vision of hell, all scalding rock and choking fumes. Since then, its surface has cooled, continents have drifted, mountains have risen and eroded, and life has emerged, benign and green. Nearly all traces of the planet as it was have been wiped away. But from clues in the oldest rocks, deepest magmas, and even the cratered face of the moon, scientists have traced the planet's beginnings. As those early days have come into focus, so have the rare scenes, found today in some of Earth's harshest places, that recall its ancient self.

Its birth pangs began some 4.6 billion years ago as rock and ice particles swirling around the young sun collided and merged, snowballing to produce ever larger planetary building blocks. In violent pileups, they smashed together to create planets, including the infant Earth. In the turmoil, another body, as big as Mars, struck our planet with the energy of trillions of atomic bombs, enough to melt it all the way through. Most of the impactor was swallowed up in the bottomless magma ocean it created. But the collision also flung a small world's worth of vaporized rock into orbit. Debris quickly gathered itself into a ball, and since then Earth history has unfolded beneath the blank stare of the moon.

After the moon's fiery birth, the Earth's surface cooled. Even so, our planet remained an alien world for the next 700 million years; scientists call this time the Hadean, after the Greek underworld. Rafts of solid rock drifted in the magma like dark ice floes. Gases hissed from the cooling rock—carbon dioxide, nitrogen, water vapor, and others—enveloping the planet in a scalding atmosphere devoid of oxygen. As the temperature dropped further, the steam condensed into rain that fell in primordial monsoons and filled the ocean basins.

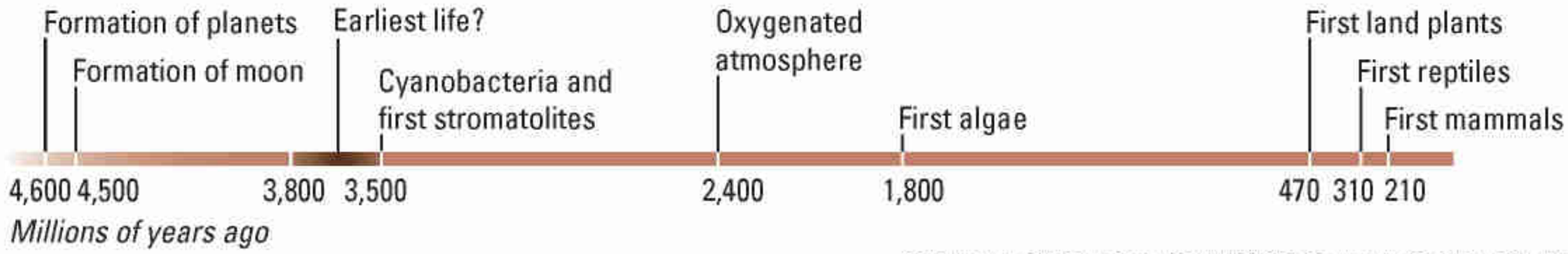
These first oceans may have been short-lived. Space rubble left over from the birth of the planets—chunks of rock tens to hundreds of miles across—bombarded Earth throughout the Hadean. The greatest impacts might have boiled the oceans away, forcing the process of cooling and condensation to begin again.

By 3.8 billion years ago the impacts relented. Liquid water could persist. About that time, perhaps in the oceans, lifeless chemical reactions crossed a threshold, producing molecules complex enough to reproduce themselves and evolve toward greater complexity. Life was on a road that led, as early as 3.5 billion years ago, to single-celled, blue-green cyanobacteria that flourished in the sunlit parts of the oceans. By the trillions, these microscopic organisms transformed the planet. They captured the energy of the sun to make food, releasing oxygen as a waste product. Little by little they turned the atmosphere into breathable air, opening the way to the diversity of life that followed.

Those days are long gone, but the processes that turned our planet from a hell to a habitable world are still on view today, as the images on these pages show. Primordial heat left over from the planet's formation still bursts out in volcanic eruptions, spilling lava that exudes gases like the young, cooling Earth. In the planet's harshest environments today, cyanobacteria reign as they have for billions of years. And each time a plant gains a toehold on newly cooled lava, the victory of life over lifeless rock—won so long ago on the young Earth—is affirmed again.

—Tim Appenzeller
NATIONAL GEOGRAPHIC STAFF

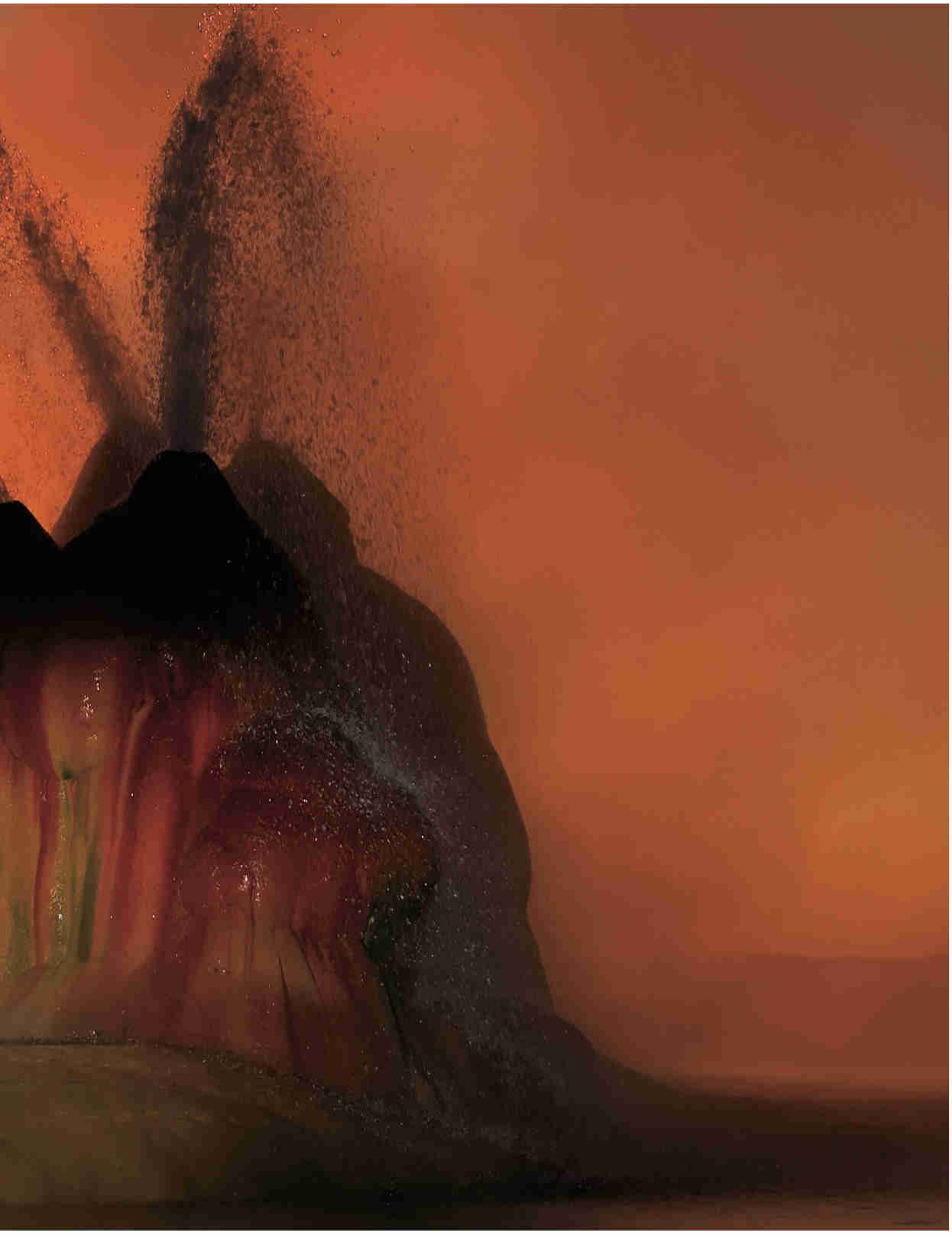
ROAD TO LIFE

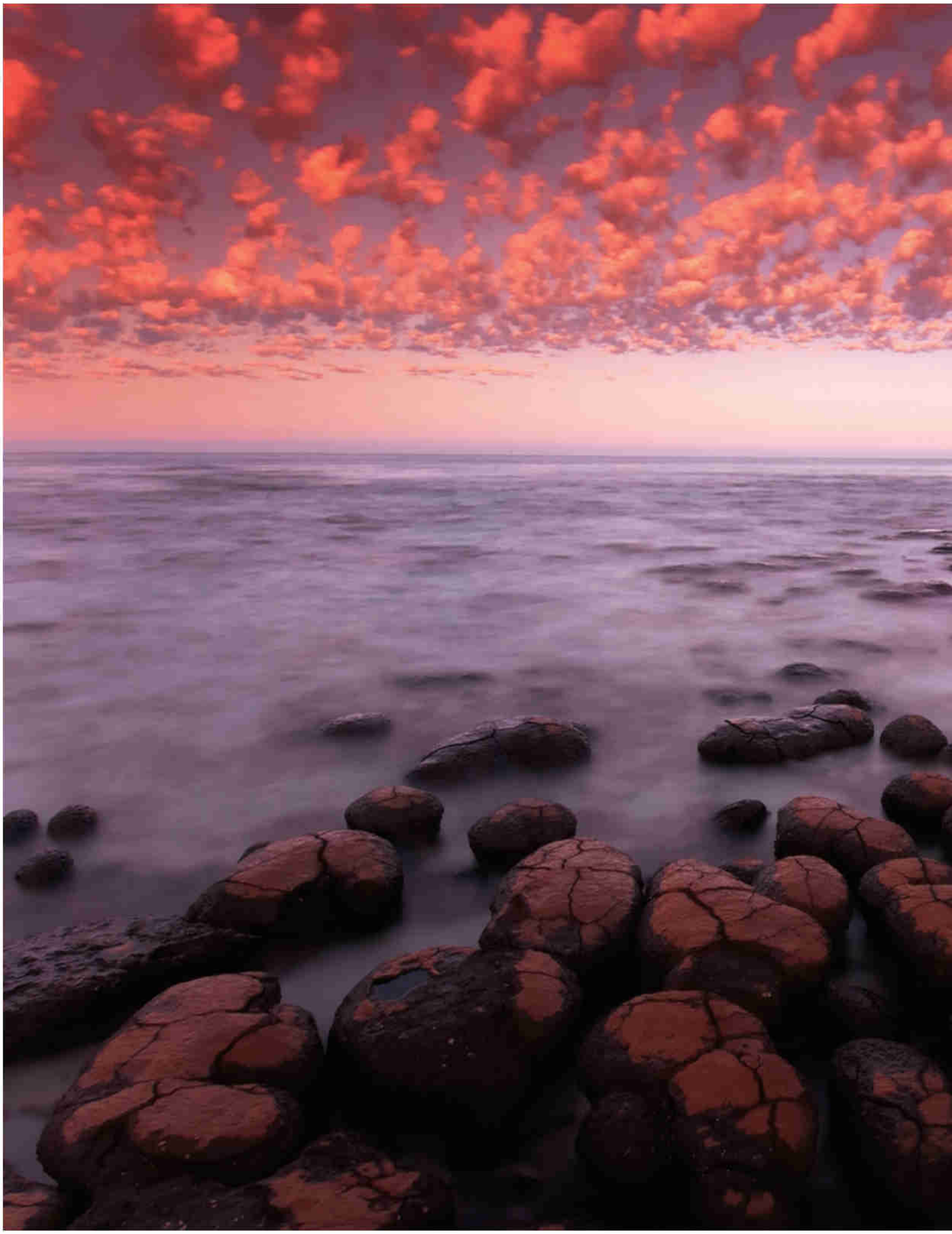


CONSULTANT: STEVEN M. STANLEY, UNIVERSITY OF HAWAII; GRAPHIC: NGM ART

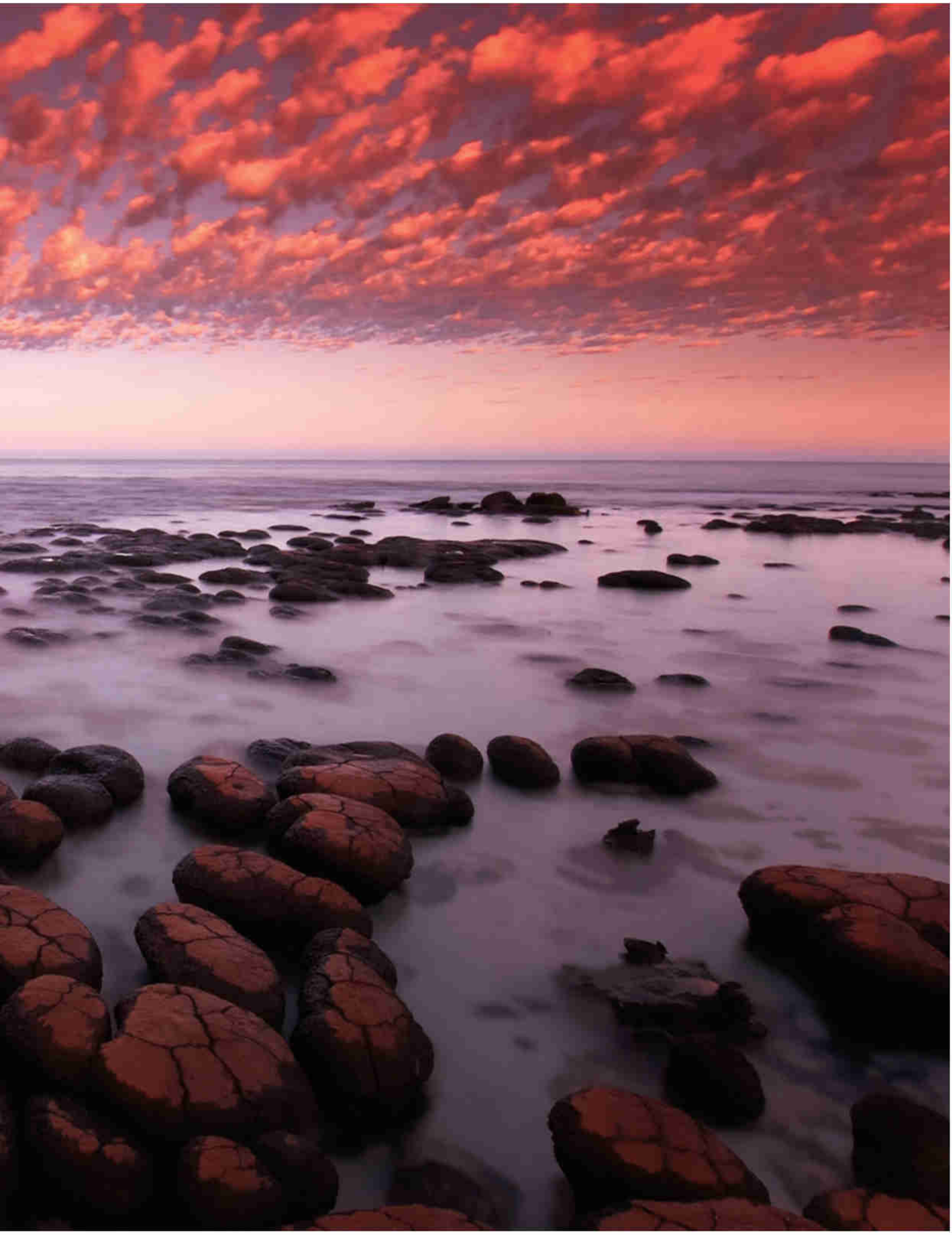
A scene from the early Earth unfolds from the rim of Puʻu ʻŌʻō crater on Hawaii's Big Island. Lava that bursts from spatter cones in the distance has filled the crater floor and cooled into a fractured gray crust. Over and over in early Earth history its surface cooled and hardened, only to be melted again by giant impacts from space.

A geyser in Nevada spews boiling water six feet into a dawn sky. Cyanobacteria—ancient oxygen-producing microbes—leave blue-green streaks on the flanks of the mound, a moist, mineral-rich environment that may resemble the setting where the first life evolved.





Part rock, part living things, stromatolites crowd the shallows of Shark Bay in Western Australia. These deposits form where colonies of oxygen-producing microbes capture minerals and sediment from seawater. Their ancient counterparts helped create Earth's breathable atmosphere.



A whisk fern just a few inches tall pioneers a recently cooled lava flow at Hawai'i Volcanoes National Park. Lacking leaves and roots—not technically a fern—whisk ferns may resemble the first plants to come ashore, almost 500 million years ago. □

Frans Lanting's images are part of his multimedia project "Life: A Journey Through Time." Visit *www.LifeThroughTime.com*.

THE HEROES THE HEALING

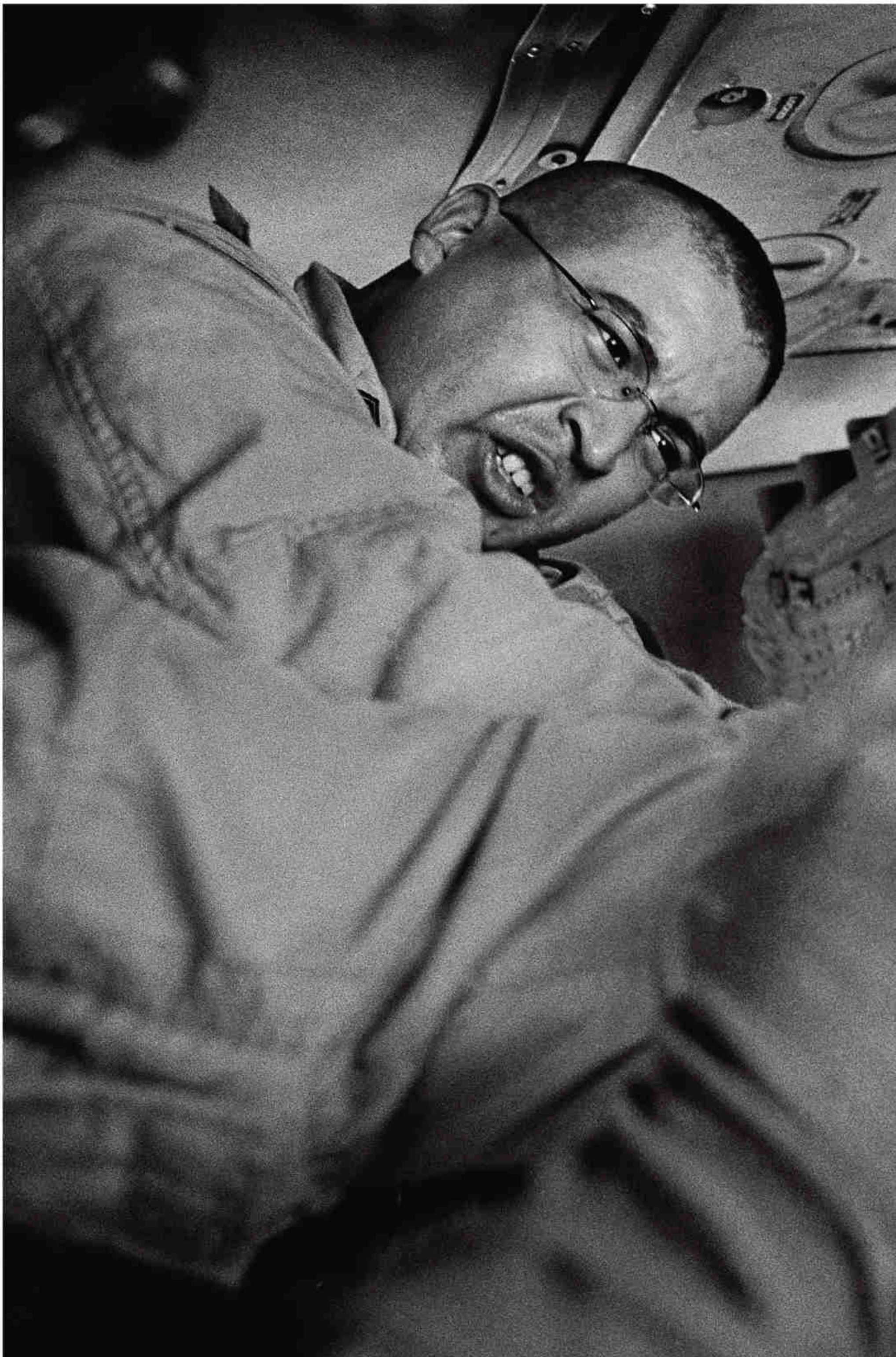
MILITARY MEDICINE FROM THE FRONT LINES TO THE HOME FRONT

BY NEIL SHEA NATIONAL GEOGRAPHIC STAFF
PHOTOGRAPHS BY JAMES NACHTWEY

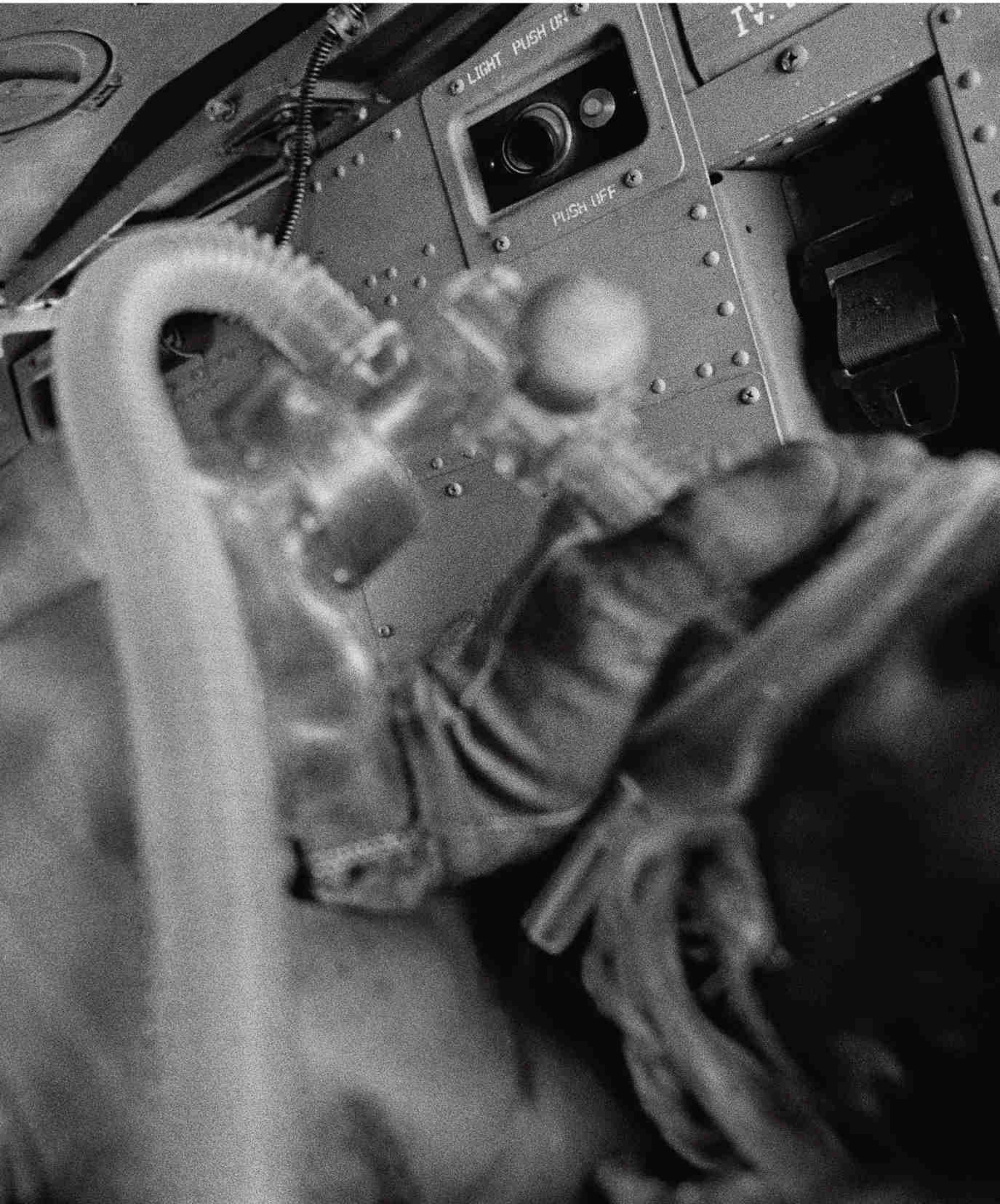
Through searing heat, American soldiers rush an injured comrade toward a medevac helicopter. Minutes before, a roadside bomb had blasted the soldier and two others on patrol along an empty road north of Baghdad. In Iraq, a battleground defined by relentless deserts, unpredictable bomb attacks, and vicious urban fighting, the military saves its soldiers with speed. The wounded are rescued quickly and propelled into a medical system that sweeps them from the front line to hospitals in the States faster than in any previous war. Once home, doctors, families, and communities help veterans rebuild their lives, one day at a time.

PART ONE

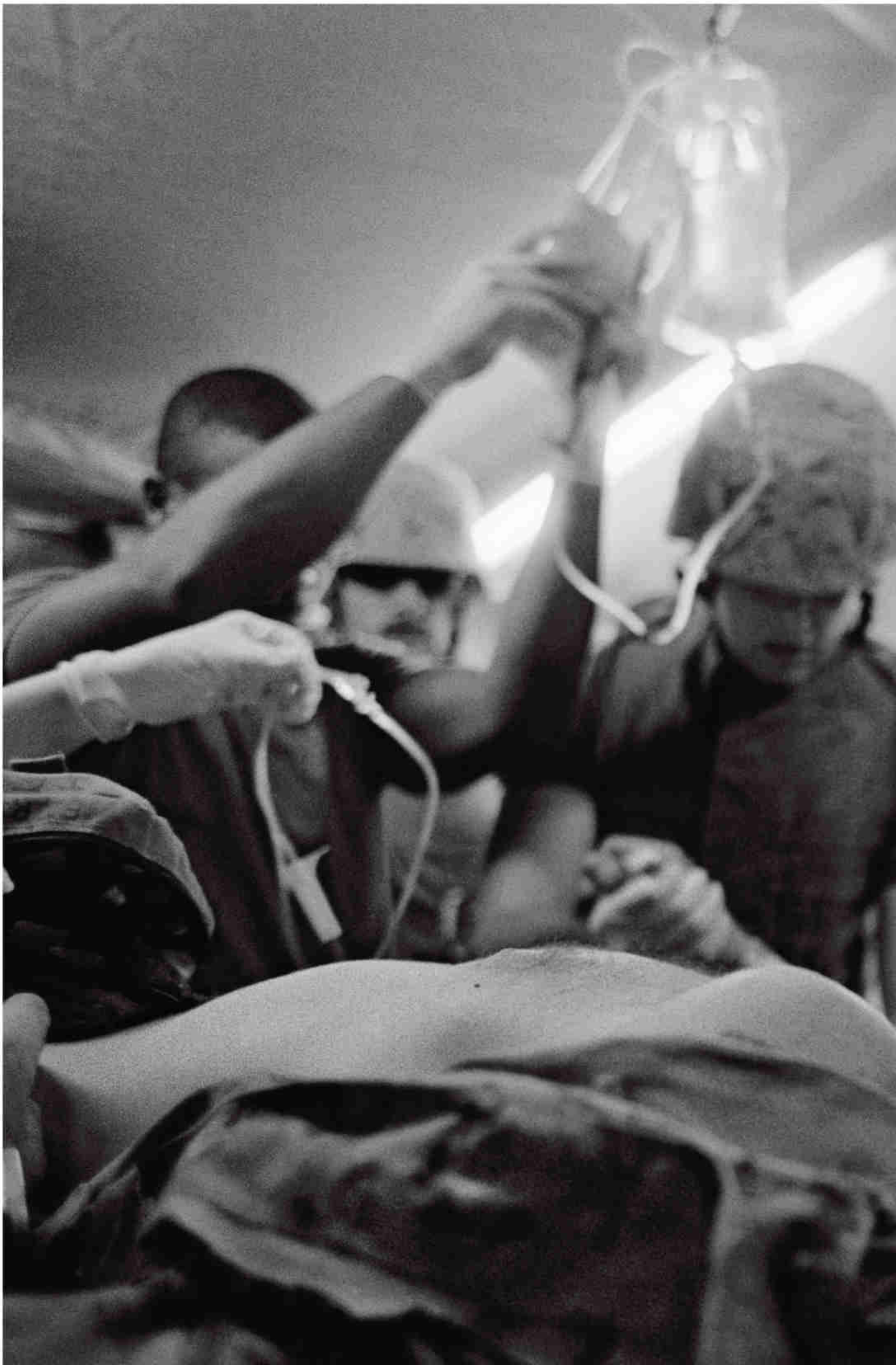
FRONT LINES



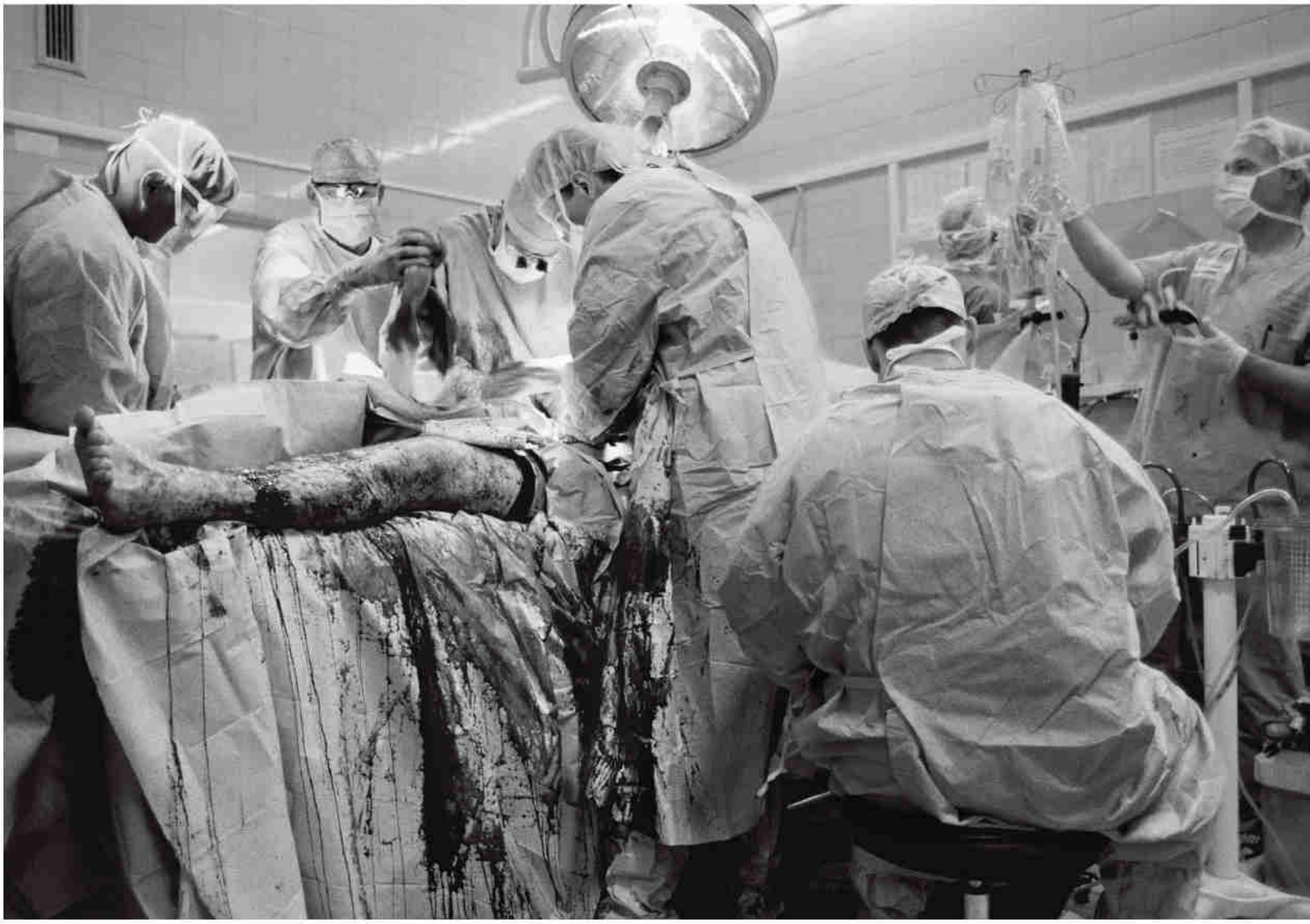
Fighting for life, medic Pablo Garza pumps the chest of a dying Iraqi soldier. Shot in the head, the Iraqi is being flown to a U.S. Army hospital in the cramped cabin of a Black Hawk helicopter. Garza's unit, one of several medevac—or air ambulance—companies based in Iraq, runs rescue missions around the clock. "It's a rush," says Garza. "I concentrate on giving the patient all the help I can. I try not to think of the outcome."



In a sand-coated tent hospital, Navy doctor Mark Hernandez, right, checks on a marine whose leg bones were shattered by an improvised explosive device (IED). The hospital, part of a surgical and trauma unit, was originally designed to break down quickly and follow frontline action. Because fighting has congealed around specific cities and towns, many such portable units have abandoned tents for more permanent facilities.

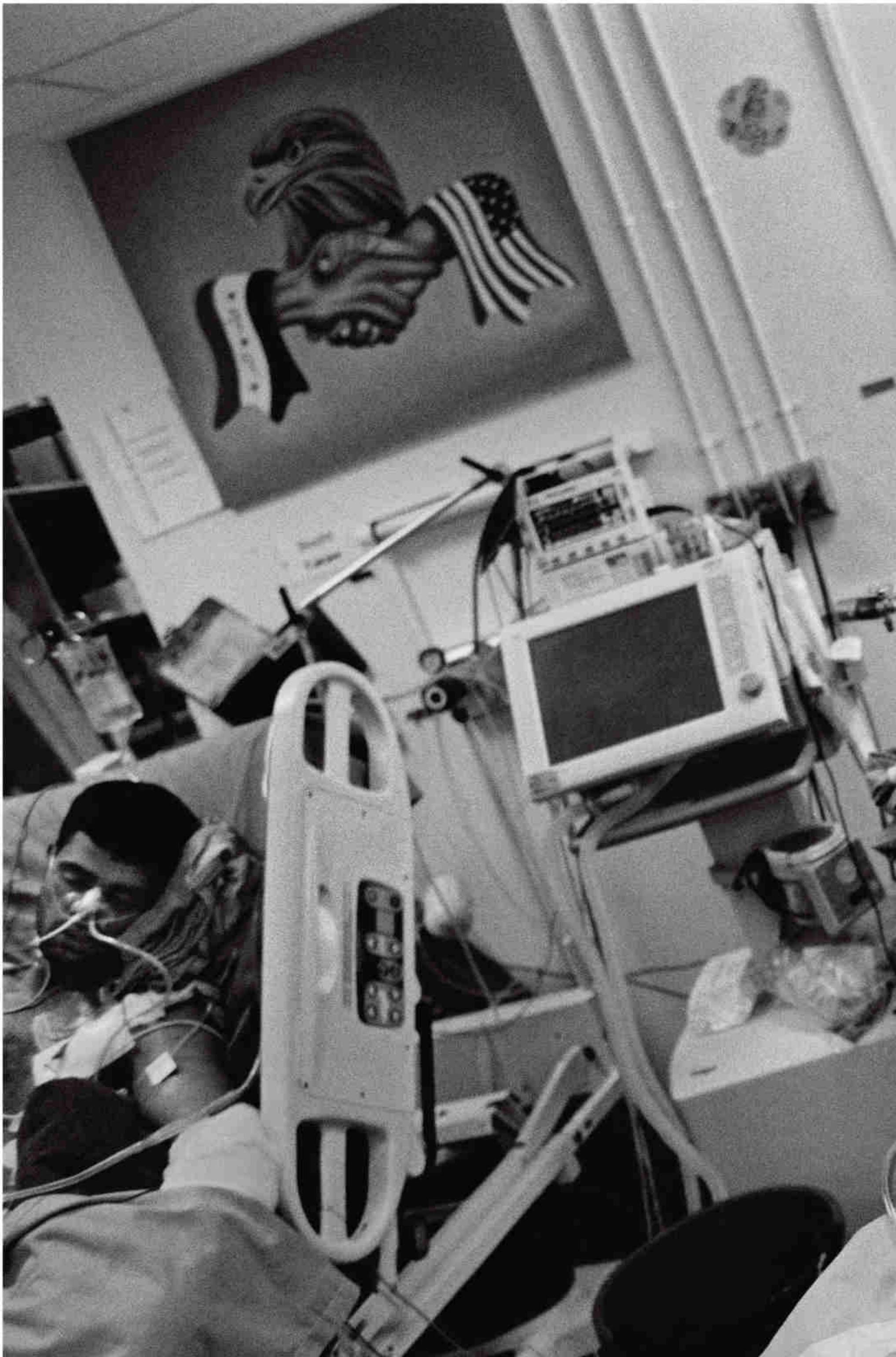


A whip of pain strikes Sgt. Bryan Price, as doctors treat him at the Air Force hospital in Balad, in central Iraq. While patrolling southwest of Baghdad, in a violent area of Sunni resistance, Price was hit by a roadside bomb. A fragment pierced his lower back, leaving him paralyzed from the waist down. Inked on his chest, a reminder of home: the name of his four-month-old daughter, Ashlynn Jaide.



A thumb-size St. Christopher medal, the gift of a military chaplain, comforts a marine in the emergency room at Al Taqaddum (opposite), a U.S. military hospital about halfway between Ramadi and another battered city, Fallujah. In remote regions, the wounded are often treated first at these small field stations. The seriously injured are then helicoptered to large military hospitals, like Ibn Sina in Baghdad (above). There, surgeons operate in a climate-controlled theater kept hot to decrease the risk of patient hypothermia. Despite Ibn Sina's state-of-the-art equipment and staff, sometimes the damage inflicted by war is too great. This soldier later died in the intensive care unit.

Fourteen-year-old Hassan is gently tended by U.S. Army nurses at Ibn Sina Hospital. The boy and more than a dozen other children and adults were gored by shrapnel from a suicide bomb in a market outside Baghdad. American military hospitals took in many of the survivors. "I don't think people know how hard we work on Iraqis," says one nurse. "Most of the patients we're taking *aren't* U.S. soldiers."



A wounded marine is cocooned in a modified body bag (opposite) at the Al Taqaddum field hospital before being sent on to better care. Called a "hot pocket," the bag is a battlefield innovation—zipping living soldiers into the bags traps body heat, ensuring that the injured stay warm during transport. Amid the smell of fuel and the whine of engines at Balad Air Base (above), a patient embarks on one more stretch of his journey: a flight aboard one of the C-17s that ferry the injured from Iraq to Germany. There, they are treated at the Landstuhl Regional Medical Center before being returned to the U.S.

The wheeze of a respirator greets Kandi and Jim Bouwma, who traveled from Racine, Wisconsin, to Landstuhl to see their son. Private Andrew Bouwma, 20, had been in Iraq only 13 days when a sniper's bullet tore into his hip. "We did a lot of praying on the way over and not much sleeping," Kandi says. "I prepped myself pretty hard not to cry in the ICU. All I was thinking is, Thank God we have you back."

THE WAR IS ON HOLD. The soldiers of Charlie 2-4 sprawl on battered chairs and couches in dust-lined rooms that stink of sweat and half-eaten meals. They stare at pirated DVDs, thumbing through gun magazines, car magazines, even copies of *Glamour*. Some wrestle like brothers cooped in a snowbound house, boots clomping past stacked rifles, insults riding over radio static. For 12 hours, nothing has happened. The men, crews of one of the busiest medevac helicopter units in Iraq, have fought only boredom. A feeling gathers that something is coming, that they're due. No one mentions it. That would break taboo.

Outside, a sea of stars spreads above the trailers and shipping containers that compose this base. The lights of Baghdad bloom on the horizon, making the place feel removed, safe, although insurgents have lately been lobbing mortars over the 20-foot walls. Elsewhere, infantry units roll out on patrols or return for midnight meals. Generators hum. Spring-armed doors clap shut as soldiers go to shower away the day's dust.

The men of Charlie 2-4 fly Black Hawks over a landscape too dangerous, too wrecked for road travel. They fly into the hot, violent cities, the mud-brick towns, the nowhere stretches of desert, picking up American and Iraqi soldiers, civilians, and, sometimes, enemy fighters. For medevac crews, there are missions, and the space in between. Earlier today, Charlie 2-4 rescued three Iraqi boys wounded in a bomb blast in a rural field. Blood and mud caked their bodies, stubs of straw clung to their bare backs like a pelt. The mission reset the clock, the psychic countdown. Now comes a rush of static and an anxious, tinny voice on the radio: Insurgents have attacked a U.S. Army patrol somewhere on a highway south of Baghdad. One of the soldiers is badly wounded.

A four-man crew sprints to the flight line, loose gear bouncing on shoulders. They stow their rifles, slip on sweat-greased helmets. The pilot and copilot spin up the Black Hawk's rotors and speed through the preflight checklists. A sweet, dizzying breath of fuel washes over them. David Mitchell, the flight medic, scans the cabin: litter pans for stretchers, four of them, jut from the sides of the helicopter like berths on a ship. Oxygen tanks, heart monitors, bandages, bags of saline, all of it ready, wedged into crooks, compartments.

The crew tenses, especially Mitchell. The tall, 29-year-old sergeant is earnest and usually quiet, a polite southern boy. Excited or nervous, his eyes widen and he curses more, a habit he's trying to curb. As he sorts the last of his gear, he swears, a single word, the sound of it lost in the clatter of rotor blades.

THE HELO SLIDES LOUD AND LOW over the desert. In the cockpit, the pilots scan for muzzle flashes, tracers, warning each other of low-hanging wires. In back, Mitchell thinks through scenarios. He decides where he will put the patient. He imagines what might go wrong, what he will do. Medics learn quickly to solve problems, or at least keep them from worsening. Much of their job comes down to plumbing: Plug the leaks, stop the bleeding. Speed is key. If medics hold fluids in, if the helicopter moves fast enough, the wounded win time.

Mitchell is from Waldo, Arkansas, population 1,600, in the southwest corner of the state. The Where's Waldo? jokes no longer amuse him. He is a father of four boys and was married on

September 11, 2001. On every mission he carries three good-luck charms. One is a gift from his parents, a crucifix inscribed with the letters K.O.S.S.—Keep Our Son Safe. The others, a black rubber wrist bracelet and a single dog tag pressed with his nickname, Deucez, and those of two buddies, Skyzap and Spyder. It is only his first tour in Iraq—some of his colleagues have done three—but Mitchell has become a character in the superstition surrounding the unit's endless days. He is called a "mission magnet": Whenever he's on duty, something happens. Tonight the proof piles up.

It is near midnight when we arrive on the scene, circling while the pilots inspect what's below. Humvee headlights carve out a landing zone on an empty road. Soldiers aim their weapons into the blackness beyond, watching for an ambush. We bump down in a cloud of hot dust. The injured man has been laid on a litter and stripped to the waist. Four or five of his comrades run the litter to the helicopter and clumsily, frantically, shove him inside. He has no pulse. Mitchell begins CPR. The helo lifts off for Baghdad.

The soldier is perhaps 20. He is lanky, with knobby shoulders—a boy's shoulders. Green cabin lights wash across his chest, his right arm flops off the litter. Mitchell moves like a piston above him. "Come on, buddy," he says. "COME ON, BUDDY." Sweat pours off him in long beads. Even with the windows open, the helo racing 200 feet above the ground, it is well over a hundred degrees. The heat, the weight of his body armor, and the frantic pace drain him. He's exhausted, losing effectiveness. After ten minutes, crew chief Erik Burns makes Mitchell get out of the way. Then Burns waves me in, a fresh set of arms.

Medics must use any resource available to them, and tonight I am one. I shove down 15 compressions. The soldier's chest feels ready to crack. I sink all my weight into it, right over his heart, his ribs buckling beneath my hands. My head pounds. Mitchell slumps beside me. We're gonna save this kid, I think. I will it true. We fly on toward Baghdad, over the flat fields, the pinprick lights, the sleeping country. The last minutes to the hospital blur past, a manic, sweat-soaked dream.

WE TOUCH DOWN on a landing pad outside Ibn Sina Hospital in Baghdad. A nurse and medic duck across the pad, their scrubs flapping in the rotor wash. They haul the soldier into the trauma room. Doctors and nurses swarm him. Someone continues CPR, others slide tubes down his throat, measure blood oxygen levels, check his pupils with a flashlight. Mitchell stands nearby, helmet tucked under his arm, downloading what he knows to a nurse. His bald head shines with sweat. Monitors beep, there is the gasp of breathing machines, the tear of bandages.

"I got blood coming out his ears!" a doctor is saying.

"Hey! I got a pulse!" another shouts. It's been five minutes since we arrived.

Mitchell grits his teeth in a tight smile and pumps his fist. *Yes.*

"I told you," he says, bouncing on his feet. "No one dies in my helicopter."

Then the mood shifts. Something is suddenly understood, it appears on the faces of the doctors. There is a pulse, nothing more. The soldier doesn't react to stimuli, shows no signs of life. There is a question about what to do. But Mitchell must leave, speed dictates, and we fly back to base to wait for the next call.

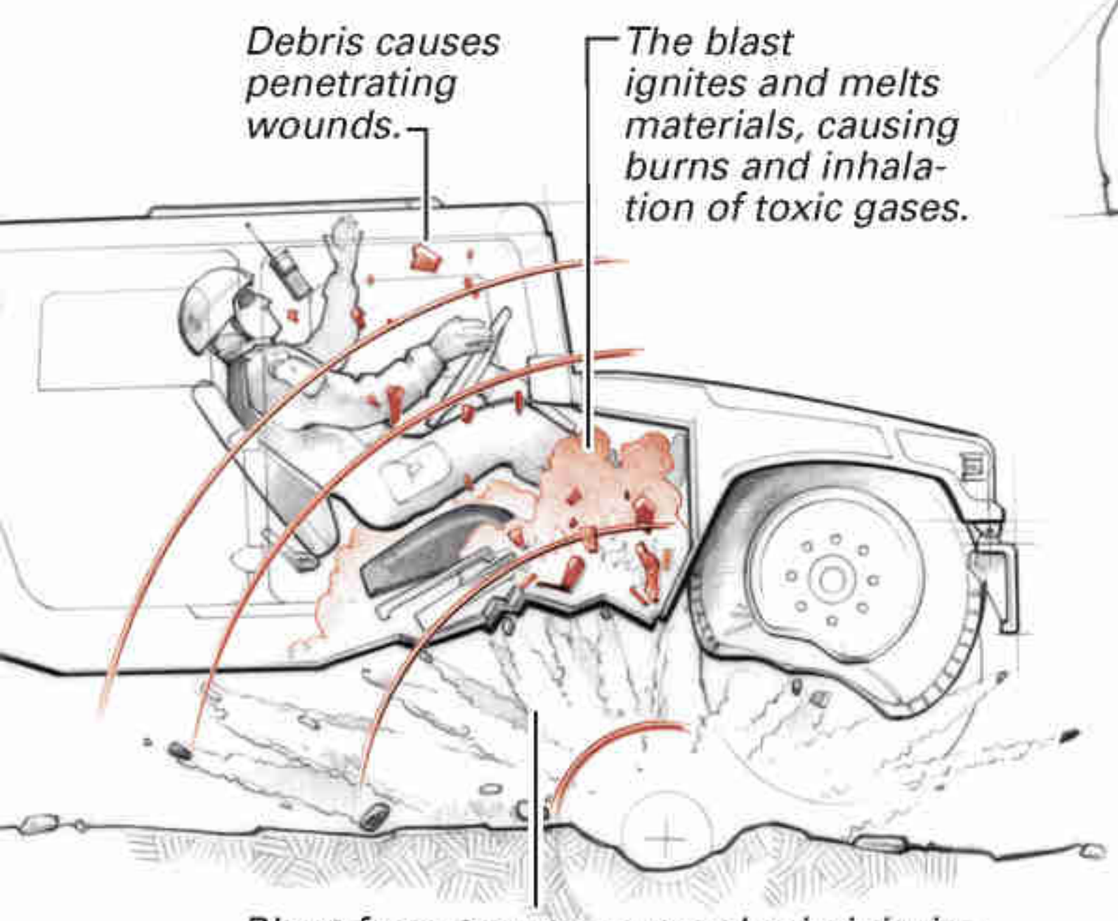
On the ground we learn the soldier's fate. Doctors discovered a metal fragment embedded deep in his brain. They decided an operation would be futile. The only hospital equipped to do that kind of brain surgery was too far away, in another part of Iraq. They pumped in pain meds, just in case, and waited for his heart to stop. For Mitchell, the flare of triumph dies. He looks at me blankly, then walks away, saying nothing. It doesn't always end like this. But these are the days the crews must get used to, the ones they never forget.

SPEED SAVES

Ninety percent of service members wounded in Iraq are surviving their injuries—up from 76 percent in the Vietnam War. Better armor and improved medical techniques have helped lower the death rate, but the key factor is fast evacuation. From the moment a soldier is wounded, the rescue system kicks into gear.

ROADSIDE ATTACK

More than half the injuries are caused by improvised explosive devices (IEDs)—devastating homemade roadside bombs and booby traps. When an IED destroys a soldier's vehicle, multiple severe injuries can occur.



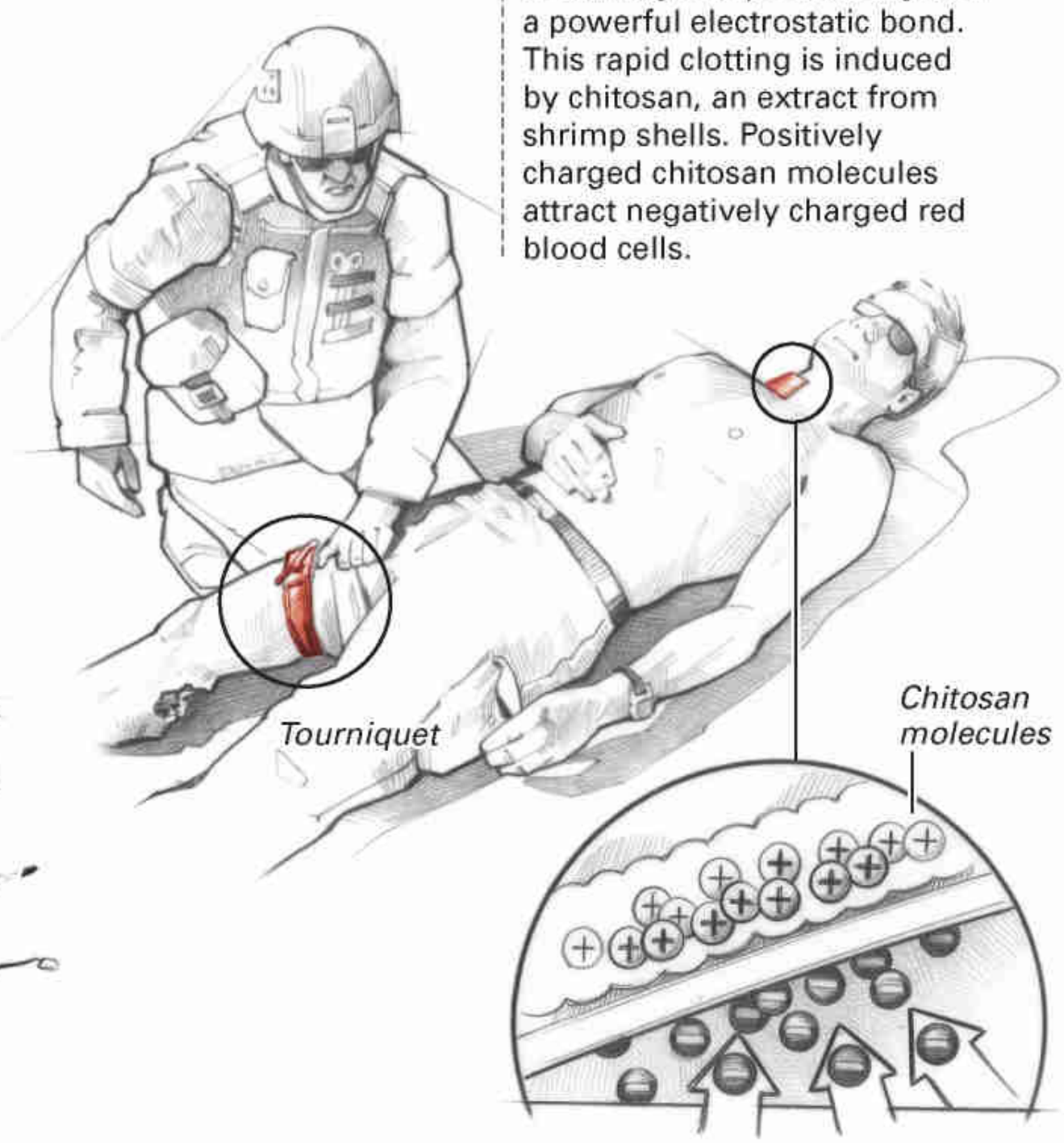
Blunt-force trauma causes brain injuries, fractures, internal injuries. Blast volume and pressure damage hearing.

WITHIN MINUTES

STOP THE BLEEDING

Arms and Legs Aggressive, short-term use of tourniquets is saving personnel who would otherwise die of blood loss. In addition to medics, many soldiers are trained as combat lifesavers; everyone carries a combat tourniquet, which can be self-applied.

Neck and Torso A new type of bandage stops bleeding with a powerful electrostatic bond. This rapid clotting is induced by chitosan, an extract from shrimp shells. Positively charged chitosan molecules attract negatively charged red blood cells.



IN IRAQ, ONE MASSIVE U.S. MILITARY machine fights the war. Another cares for those injured in battle. The effort is enormous, unrivaled. Medical procedures and body armor have vastly improved since America's last comparable war, in Vietnam. Yet the techno-sheen given this war by smart bombs, night-vision goggles, and remote-controlled drones is misleading. It is not miracle technology that saves lives on the battlefield in Iraq. The most important tools are tourniquets, the most important methods timeworn.

Trauma care proceeds in stages. It begins on the battlefield, with medics pulling bandages from their backpacks, often under fire. Some wounded are then rushed to small field stations like the one at Al Taqaddum, where Navy surgeons operate on marines fresh from the urban hell of Ramadi.

Others are airlifted directly to larger hospitals such as Ibn Sina, a former Baathist facility, where the wounded arrive around the clock. When they are stable, patients are flown, IVs snaking from their bodies, nurses monitoring their vital signs, to a military hospital in Germany. Then, at last, they return to the United States for final procedures, recovery, family.

All this can happen in as few as 36 hours. The process rivals FedEx in complexity and tempo. Soldiers become warm packages, bundled and gently tended, hurtled across time zones in the bellies of cargo planes. Often they are drugged

WITHIN HOURS | 1-3 DAYS | 3 DAYS OR MORE

EVACUATE

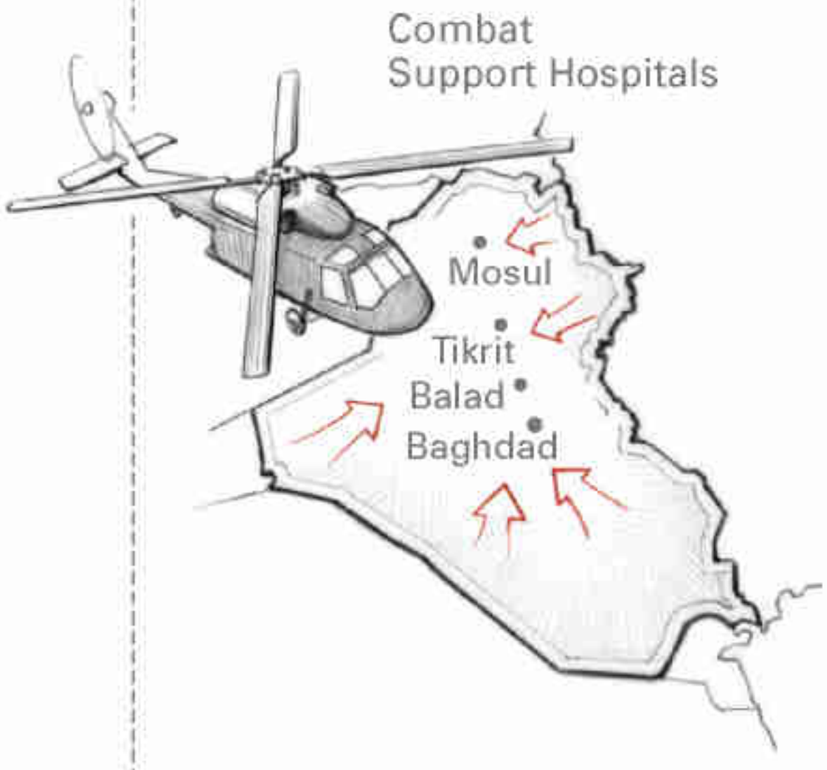
American air superiority ensures that no one is more than 30 minutes from the next level of care. Forward Surgical Teams man tent hospitals. Black Hawk medevac crews usually carry wounded directly to more fully staffed military hospitals.

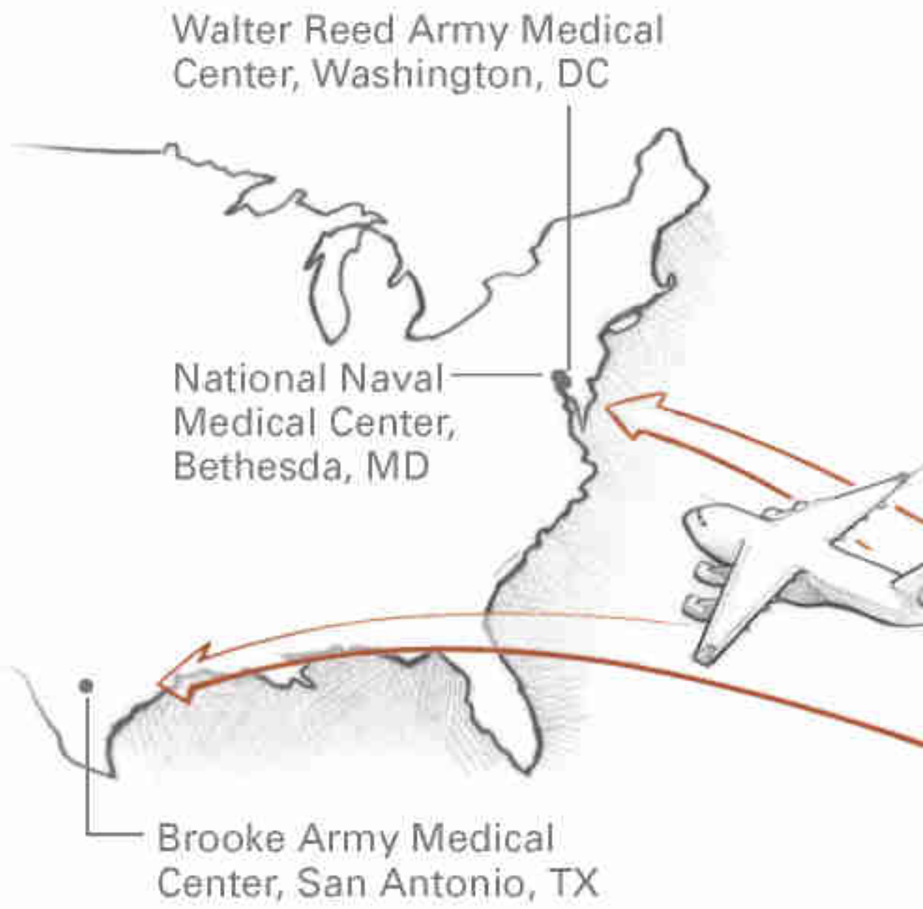
STABILIZE AND TRANSPORT

Critical care teams transport the wounded in flying ICUs—converted C-17 cargo planes—to the military hospital in Landstuhl, Germany. Personnel are flown out of Iraq for any wound or illness requiring more than three days of recovery.

REHAB AND RECOVERY

From Landstuhl, wounded or ill service members are flown to the U.S. Many of these include amputees and those with traumatic brain injuries, whose rehabilitation may require lifelong care. The first stop is most often Walter Reed or Brooke, which specializes in burns.





Keep It Open Some wounds are best left open during air transport to prevent internal swelling, which can cause a dangerous drop in blood pressure. Surgeons cover open abdominal wounds with an antimicrobial surgical drape. The semipermeable membrane adheres securely to wound edges and helps prevent further contamination.

REPORTED BY KURT MUTCHLER AND BRENNA MALONEY; DESIGNED BY JUAN VELASCO; ART BY BRUCE MORSER

SOURCES: "CASUALTIES OF WAR—MILITARY CARE FOR THE WOUNDED FROM IRAQ AND AFGHANISTAN," ATUL GAWANDE, *NEW ENGLAND JOURNAL OF MEDICINE*; COL. DAVE ED. LOUNSBURY, RET'D; HEMCON MEDICAL TECHNOLOGIES, INC; U.S. ARMY INSTITUTE OF SURGICAL RESEARCH; *EMERGENCY WAR SURGERY*, THIRD UNITED STATES REVISION, BORDEN INSTITUTE; 3M

and remember little of the journey, waking in hospitals in Washington, D.C., or San Antonio, Texas, to find their worlds, their lives, have changed. For soldiers arriving in the "sandbox," as Iraq is often called, knowledge of this global lifeline boosts morale and relieves some of the stress that comes with heading into battle or patrolling roads clotted with bombs.

At Ibn Sina, the largest Army hospital in Iraq, staff boots tell stories of war. In calm hospital wings, boot tops are soft and clean. In the trauma room, they are splotched and matted with blood. The floor is a dump, often slick with red pools, littered with bandage wrappers, scissors, shreds of clothing, charred skin. Boots are necessary. At the nurses' station just inside the hospital entrance, all the boots have been baptized in blood.

It is lunchtime. Young medics and nurses cluster at the large wooden desk laughing and joking. Some wear surgical clamps clipped to their pants, always ready, just in case. Others tuck tape and syringes into their pockets. Nearby, Iraqi janitors swing mops lazily along marble floors that Baath Party elites, including Saddam Hussein and his family, once crossed on their way to receive privileged medical care. There is a faint odor of disinfectant and feces.

The staff at Ibn Sina is part of the Army's 10th Combat Support Hospital, or 10th CSH, pronounced "cash." Many of the war's worst casualties, from wounded coalition and Iraqi

personnel to civilians and insurgents, are helped here by some of the best trauma teams in medicine. The hospital treats hundreds of patients each month. It does not mirror the sleek, high-tech civilian institutions in the U.S. or Europe. It is battle-ready and rough, the rooms cluttered with equipment, some of it aging. Occasionally, the electricity fails.

But then, war medicine is not civilian medicine. It's dirtier, faster. The wounds are worse, the patients at greater risk. Here medical teams cut, crack, and inject where their civilian counterparts might pause and worry about lawsuits. Ibn Sina is designed for life-saving procedures, not the long recoveries required by amputees or burn victims. The mission is simple: stabilize patients, ship them on to facilities equipped for longer term care.

"There are no litigious restrictions over here," a lieutenant colonel who is also a doctor tells me. "People play fearlessly, and when they play fearlessly, they make fewer mistakes. It's a dose of reality you'll never forget. The surgeons, nurses —never in the rest of their lives will they be who they are here."

The 10th arrived here in October 2005 to replace another CSH unit at the conclusion of a year-long tour. Few of the 10th's nurses or medics had ever seen the chaos of big trauma. Many are in their early or mid-20s; some had cared previously for cancer patients or the elderly. Iraq was immediate, terrifying immersion.

Lt. Col. John Groves, 42, head ER nurse, trained in some of America's busiest trauma centers, including Miami and Honolulu. He is a short, friendly man, a career soldier who, if prompted, can talk into the night about past cases and calamities, the mutilations of this war. He is a self-described steel-mill kid from Indiana, and on his desk lie photos of the 20 or so head of cattle he keeps on his new farm in Kansas, where he plans to retire.

Groves is a father figure to his young staff. He watches them carefully, knows their strengths, their weaknesses. He remembers thinking not all of them would last.

"So many were timid, they didn't know what to do. It was a hard adjustment, and not everyone is cut out for this kind of medicine." Groves was ready to reassign several nurses to other wards. Lt. Riane Nelson was one of them.

She is 24, a tall round-faced blonde from San Diego with blue-green eyes that shift color depending on the scrubs she wears. From the time she was eight, she wanted to be a nurse. She lived then in Greece, where her parents worked as missionaries. After college, she joined the Army. She didn't have any trauma training before she arrived in Iraq.

Nelson grew up an athlete. She knew what it meant to work hard, play fast. But she struggled with the crushing pace of the trauma room, the weight of decisions made amid blood and fading lives. She forgot things, made mistakes. She began, she says, to crack. Then, slowly, the weeks of panic yielded to smoothness. She remembers when the conversion came.

VALENTINE'S DAY, 2006. Nelson hopes for a slow shift. But somewhere in Iraq, an Army convoy hits a roadside bomb and a medevac helicopter rushes in a seriously wounded soldier. The situation is going badly.

The soldier arrives medically dead. A tourniquet encircles the right leg. Below the tourniquet, the limb hangs by threads of flesh. The femoral artery is like a severed hose. There is the coppery smell of blood.

Nelson stands at the head of the bed, feeling for a pulse, giving directions. Medics slice away the remains of a uniform. Nelson realizes her patient is a woman. She has no pulse, she is drained of blood. Nelson orders someone to begin CPR, even though in her experience it has never saved anyone. A doctor calls for drugs: atropine, epinephrine. Nelson injects them into the woman's body. Finally, she feels the weak flutter of life. "After about five minutes of CPR, I felt a carotid pulse," Nelson later wrote in her journal. "We double- and triple-checked to make sure we weren't just so hyped up that we were feeling our own pulse in our fingers."

"She's brought people back from the dead. Our joke is if you come in dead, you want Nelson at the table."

LT. COL. JOHN GROVES

Nelson's team pumps blood into the woman; it runs out her shattered leg. To save the life, the limb must go. A surgeon slices. Someone loops another tourniquet around the stump. The team bandages the wound and preps the woman for the operating room, where surgeons will clamp off her artery, insert a chest tube, and clean shrapnel from her body.

After surgeons saved the woman's life, Nelson visits her upstairs in the intensive care ward. She finds the woman's husband at her bedside; the couple serve in the same unit.

"That was one of the more emotional cases I've had," Nelson says. "I think that's where I gained my confidence. With her, I felt I took charge. I felt I had peace of mind, I wasn't freaking out. And, on Valentine's Day, I didn't have to say, 'Your wife didn't make it.'"

Groves, her boss, noticed the change and kept her on. "Now she can do anything," he says, smiling. "She's brought people back from the dead. Our joke is if you come in dead, you want Nelson at the table."

After months in Iraq, Nelson and her colleagues have helped save hundreds of lives. They have seen more human wreckage than most of their stateside peers ever will. Their stained boots are badges of honor. In the late winter, it was common to hear young nurses and medics say, "I never want to leave." Older staffers shared the sense of purpose. Many said, "If it was a little safer and I could bring my family here, I'd stay." The work, the importance of it, was exhilarating.

By summer, past the halfway point in the 10th CSH's tour, those feelings have faded. A makeshift calendar hangs on the wall beside the nurses' station, each remaining day in Iraq marked on a slip of white paper. Home is not simply a place, it is a goal. Everyone yearns for a life less cloistered, closer to family and old routines, away from war.

Many have taken mid-tour leave. The two weeks' vacation either recharged them or intensified the desire to leave. "Before I went, I was not doing well," Nelson says. "I was starting to have dreams about patients, like, what could I have done differently." The break refreshed her, gave a boost she hopes will last till the tour is up. When I see John Groves again, after his leave, there is a new weariness, a heaviness in his face. "I'm ready," he says. "I think we all are."

The end will come soon enough, but heading home won't be simple. The memories will follow, and more. Groves worries that many of the young staff will be bored when they return to stateside jobs at base hospitals or troop clinics. "The medics and nurses here are doing things that only doctors do back in the States," he says. "I'm teaching 20-year-olds how to put in chest tubes. When they go back, they won't be able to do that stuff."

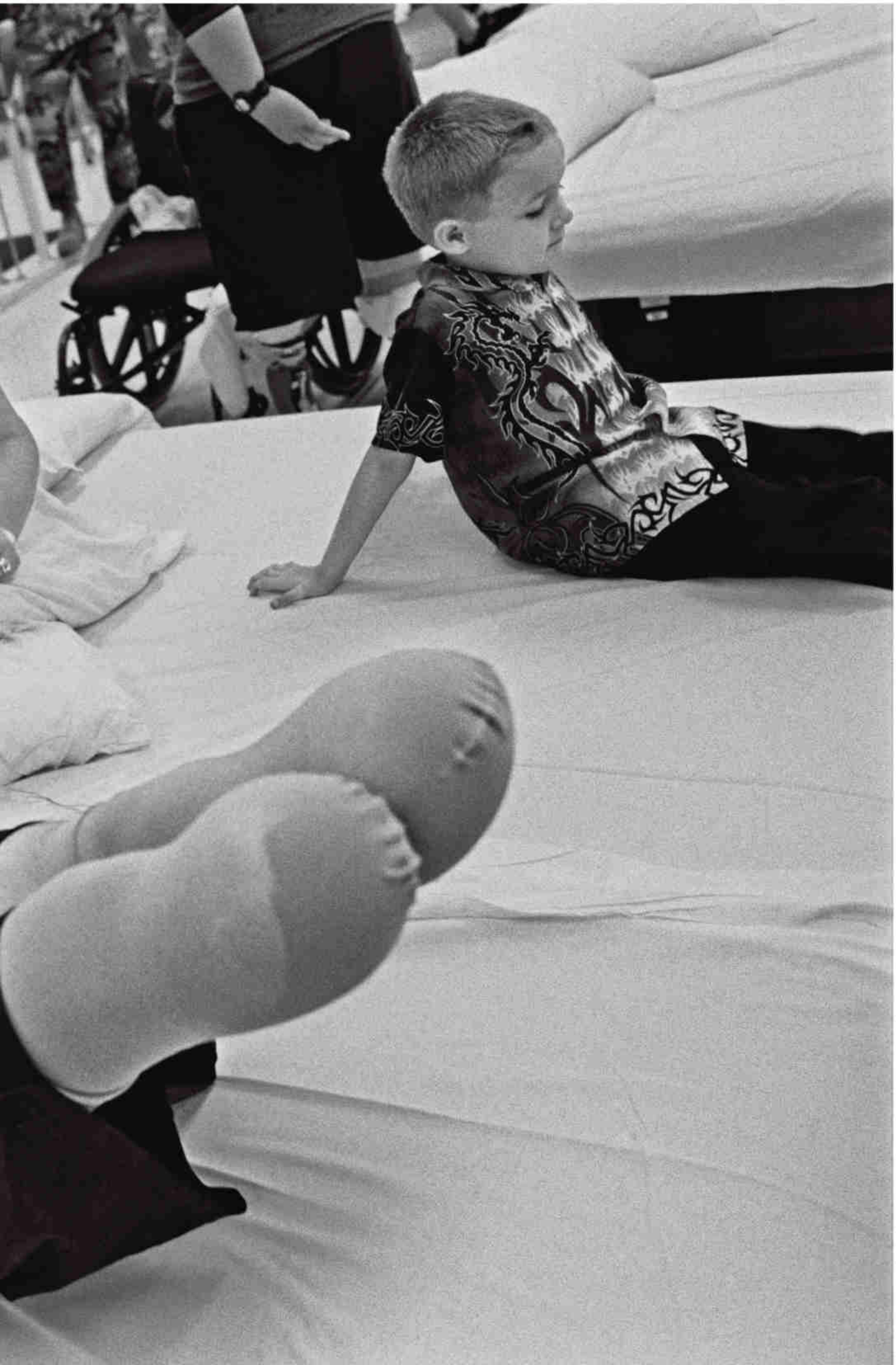
No one at Ibn Sina may ever feel as useful or needed as they do saving lives in Baghdad. It is not that the trauma crews hope for more wounded. It is not that they want the war to limp on forever. But they have an overwhelming desire to put their training into practice. The same can be said about medics like David Mitchell—about almost any soldier doing medicine here.

"We're like vultures, kinda," a nurse explains late one night as we sit waiting for the thump of incoming helicopters. "This is what we do. We're not out there stopping the fighting, so we're waiting to go to work."

For them trauma is exciting. A cloud descends, blocking out the rest of the world. There is only the work, the bright red immediacy of blood. In the trauma room, a simple truth rises above the gasp of breathing machines and the high, frantic voices: Life is everything; it is all that matters. The details come later.

PART TWO
HOME FRONT

New life begins surrounded by family at Walter Reed Army Medical Center in Washington, D.C., where Sgt. Brian Saaristo builds strength to walk on prosthetic legs. Modern, computerized limbs require strong core muscles; fortunately, most soldiers are fit—and determined. "We treat them like varsity-level athletes," says Capt. Matthew Scherer. "For them, it's not just 'Give me a prosthetic leg.' It's 'Get me running again.'"



He lost part of his skull, his right eye, and both legs to a roadside bomb. Corporal Tim Jeffers was so severely injured that doctors suggested taking him off the respirator. His father refused. Now Jeffers practices walking at the veterans hospital in Palo Alto, California, waits for reconstructive skull surgery, and yearns to rejoin the world. "I can't wait," he says. "I'm the same person I was before I got hurt."

At a surfing clinic for amputees, Specialist Andy Soule, 26, hauls himself toward the breaks off the California coast, showing the same fierce drive that many injured soldiers share. Soule, who was wounded in Afghanistan, later won a contest during the clinic—by doing handstands on a surfboard. He plans to try out for the U.S. Paralympic cross-country ski team.


REGION III

A long day catches up with Joey Bozik, 28. Bozik and wife, Jayme, were married while Bozik recovered from his wounds. "People congratulate me for staying with him," Jayme says. "But I love him, and that's what love is." A California group, Sentinels of Freedom, helped the couple with housing and other assistance. Sentinels founder Mike Conklin says, "We're just doing what every other community should be doing."

JASON WELSH HELD THE PHONE CLOSE AND LIED TO HIS MOTHER. He told her he'd been in a car wreck in Iraq, but he was fine. "I think I broke my jaw pretty good," he said, "but that's all." The lie made sense. Telling the truth, that he'd been blown up by a roadside bomb, his neck was broken, his face smashed, that three men died beside him, somehow didn't seem right. Welsh, 25, remembers thinking, If I don't tell her, it'll be OK. It'll be like it didn't happen.

Lynne Welsh, listening in Oklahoma, didn't believe him. Her mind spun. Fear flooded in. "I was so scared my voice got weak," she says. "I finally asked him, 'How are your arms and legs?' "

The question reveals the dread of every military parent, spouse, girlfriend, or boyfriend. The answer would shape the Welshes' future. Dreams would survive, or shatter. "My arms and legs are fine, Momma," Welsh said, and that, as far as it went, was the truth.

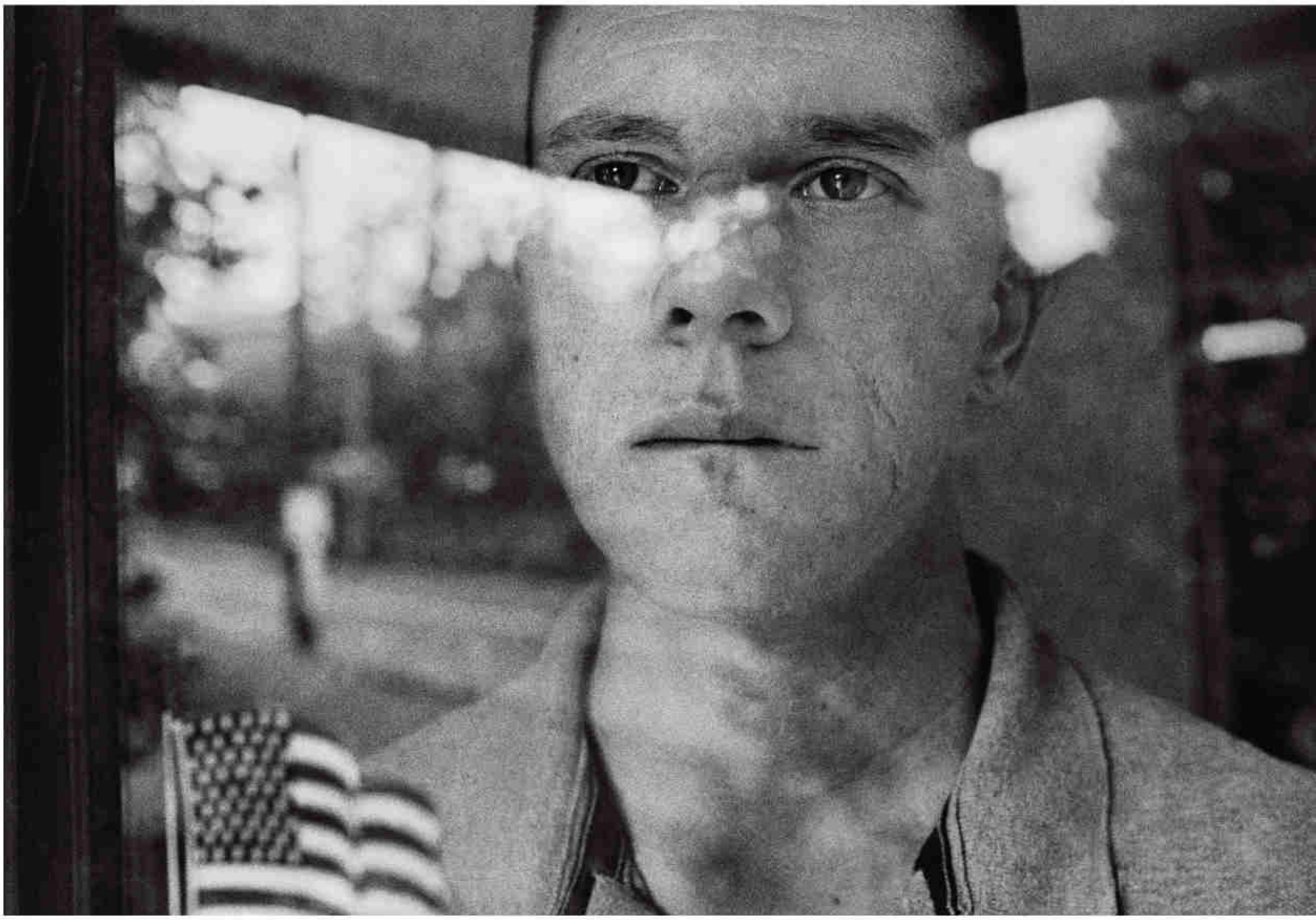
Some 20,000 American service members have been injured since the war in Iraq began in 2003. Medical technology and the sheer speed of rescue and treatment have increased soldiers' chances of surviving wounds that would have killed them in previous wars. But any notion that body armor and medicine have somehow made this war safe is unfounded. Stacking armor on troops and vehicles has only bred more accurate snipers, more devastating bombs. Medicine, while more advanced than in previous wars, cannot wipe out the brutality of the battlefield.

On American streets, amputees offer the most public and visually jarring testimony of war. The human eye, drawn to symmetry and startled by its absence, cannot help but scan voids where legs or arms once swung, while the mind wonders how it happened. But there are other injuries, some far worse than amputation.

Of the wounded, more than 20 percent have suffered traumatic brain injuries, called TBIs. As the roadside bomb, or improvised explosive device (IED), is the signature weapon of this war, the TBI has become its legacy, says Dr. George Zitnay, a neuropsychologist with some 40 years experience treating brain injuries. Zitnay, 67, has described brain injury as an "invisible epidemic," a plague the public knows little about or is unwilling to face. Zitnay believes this is because brain injuries carry heavy stigmas. "You get a brain injury in this country, you keep it quiet because here we value intellect so much," Zitnay says. "It's a very frightening thing to think about the psyche, to think about the mind. If you were brain injured, would you want people to know about it?"

After the Gulf War, Zitnay helped found the Defense and Veterans Brain Injury Center, now the military's premier brain injury program. The fate of Vietnam veterans pushed him to do it. Many of them, he says, returned with brain injuries that went undiagnosed and untreated. "They ended up in prisons and hospitals, on the street, undergoing divorces," Zitnay says. He sees some of the same things happening to Iraq vets today. "So many of these troops get redeployed so often. Their time in the war zone gets extended, their exposure to blast injuries is high. When they come back, we're not really screening them for concussions or other types of brain injuries. Often in people with mild or moderate concussion, it doesn't show up right away."

Mild brain injuries generally don't permanently impair a person's ability to function. More important, nothing is lost of the victims' essential nature—they remain who they were before injury. In more severe cases, the victims become violent, forgetful, manic. In the worst cases, the body returns from the war alive, but the victim does not. The old self is obliterated, fragmented, lost in furrows of gray matter that



STAFF SGT. JASON WELSH IN CHARLOTTESVILLE, VIRGINIA

medical science does not fully understand and cannot repair.

Staff Sgt. Jason Welsh is slim and tall, his brown hair buzzed short, his face smooth and boyish. A black-ink tattoo spreads across his right forearm, a warrior angel he got while stationed in Germany. Another tattoo, a ring of flame, circles his left elbow. Both his parents served in the Army, and Welsh joined not long after high school. He wanted freedom, but with boundaries. "I didn't want to depend on anyone," he says. "I wanted to go out on my own, and the Army was the easy way to do it." He went to Iraq first in 2003 as a mechanic, found it disappointing. Afterward, he re-enlisted as an infantryman.

Welsh returned to Iraq in late 2005 with Bravo Company of the 2-6 Infantry, 1st Armored Division. The division deployed to Ramadi, the seething Sunni city wedged against the banks of the Euphrates River west of Baghdad. Welsh commanded two riflemen and a machine gunner. His unit patrolled garbage-lined streets renamed in desire and homesickness after young female celebrities, Route (Britney) Spears, Route (Jessica) Alba. The men skirted puddles of sewage, kicked in doors during raids, battled insurgents as temperatures needled toward summer. Once, he watched Iraqi soldiers throw down their weapons and flee under fire from insurgents. It was all an education. Welsh loved it.

The young sergeant had never been hit by fire. He was on patrol one night, steering his Humvee at the head of the column, his platoon leader, a translator, a roof gunner, and a 19-year-old medic named Nick Crombie riding with him. Crombie was an energetic kid, new to the unit,

so eager to please he made mistakes in his excitement. But Welsh could work with that. He put Crombie in the back, had him sit where he could pass out Gatorades during the patrol. It was a Wednesday night in June, a night like any other. Then the truck burst.

An unarmored Humvee weighs about 5,200 pounds. Many Humvees used on combat patrols in Iraq are augmented with steel plates and bullet-resistant glass that weigh an additional 3,000 pounds or more. The trucks are wheeled rhinoceroses, stout and tough. The blast that injured Welsh pulped his armored Humvee. It blew off the wheels, doors, the trunk, everything but the seating area. The platoon leader, the translator, and Crombie were killed, the roof gunner seriously wounded. Shrapnel carved them apart. But not Welsh. His injuries—the broken neck and face, a damaged knee—were caused by the blast concussion itself or from the force of it whipping his body against the truck. He doesn't know how he survived the flying metal. "It's as if I took a bowlful of Doritos and threw them at you, and somehow they all went around you and missed," he says.

By Thursday, the day after, Welsh was in the U.S. military hospital in Landstuhl, Germany. On Friday, he landed in Washington, D.C. He remembers blurry scenes from the journey, scraps of dialogue. "I woke up, and I was really violent," he says. "I was strapped down, and I didn't want to be. They stuck something in me, and I went down. I think I was on a plane." It may have been during his journey to Germany, or his way back to the States. Such experiences are not uncommon for seriously injured soldiers who've been drugged. Welsh's first coherent post-blast memories begin at Walter Reed.

WALTER REED ARMY MEDICAL CENTER in Washington, D.C., is a sprawling collection of buildings, some of them nearly a hundred years old. The grounds are green and tree-lined, lending the feel of a college campus—except for the shotgun-slinging guards at the main gates. Walter Reed has treated U.S. wounded since World War I. It is not the sole military hospital in the nation; marines are often shipped to the National Naval Medical Center in Maryland, and some soldiers fly to Brooke Army Medical Center in San Antonio, Texas—but Walter Reed remains a critical hub for soldiers returning from Iraq.

Incoming wounded are sent to various hospital wards and intensive care units. From there, mildly wounded soldiers receive treatment and may be released, either back to their units or to hospitals run by the Department of Veterans Affairs. If they are medically discharged from the military, soldiers may also head home with family. Soldiers suffering more severe wounds, including amputations, recuperate at Walter Reed, where teams of doctors, nurses, and therapists monitor their recovery and battle the nagging details of post-wound care: persistent infections, bedsores, depression. Often patients stay at Walter Reed for months, their days organized around doctor consultations, surgeries, therapy—physical or occupational—or fittings for prosthetic legs and arms. The hospital encourages family visits. Some parents arrive before their sons or daughters, staying on campus, watching their children struggle into new lives.

Jason Welsh arrived at Walter Reed on a Friday in mid-June. His parents flew in the same day. In a photo taken shortly after their reunion, a black bruise curls under his right eye, cuts dot his forehead. His face is jaundiced, swollen, and he stares unsteadily at the camera like a drunk. He wears a neck brace. Welsh's neck was broken at the first cervical vertebra, or C1, the point where the spine meets the skull. It is one of the vertebrae that snapped in the late Christopher Reeve's neck when he was thrown from a horse in 1995. Reeve, famous for his role in Superman films, was paralyzed from the neck down. Welsh's spinal cord escaped damage, and doctors decided to let the wound heal without surgery. Soon after his arrival, he was released to Mologne House, a dormitory-style building on the Walter Reed campus where soldiers live during recovery.

Alone for the first time, Welsh woke confused, uncertain about where he was, what he was

"Imagine you can only know one thing in the world. And that one thing is that you don't know anything."

STAFF SGT. JASON WELSH

doing. It occurred to him that he should arrange his things and prepare to leave. "I was trying to get my stuff ready. I dumped all my stuff on the bed, but I couldn't figure out how to organize it," he says. "I would start doing something, and I'd forget what I was doing. I couldn't match items like socks. So I said 'screw this,' and I threw everything on the floor."

Welsh asked his Mologne House roommate for help. The man brought Welsh to the hospital and apparently left him alone. "I didn't know where I was. I didn't know how to figure out where to go. I was mindless." Eventually, a woman who had worked Welsh's case saw him. She asked why he'd missed his appointments. "I was like, 'Who are you and what appointments are you talking about?' " The woman recognized something was wrong. She brought Welsh to a neurologist. Doctors performed memory tests, gave him an MRI. They diagnosed him with TBI. At first Welsh couldn't believe it. But nothing made sense anymore, and he could barely string together words for an argument. "Imagine you can only know one thing in the world," he says, "and that one thing is that you don't know anything."

There had been other signs. Welsh's parents, Lynne and Earl, though relieved to see him alive, were worried. They tried to comfort their son and help him recover. He wouldn't have it. He cursed in fits. One day Welsh couldn't figure out how to put on his sweatpants. He exploded when his father offered to help. Then Welsh told them to leave, go home. Confused and frightened, they agreed. Shortly afterward, Welsh's younger brother Aaron came to visit. Welsh raged at Aaron, yelling and screaming. This was not the Jason his family remembered. It was as if someone else had come back from the desert.

American soldiers wear helmets that wrap their heads like tortoise shells in layers of ballistic fabric and resin. But they are not bulletproof. Snipers know this. The helmets also provide only limited protection against powerful blasts produced by IEDs, like the one that hit Jason Welsh.

Head injuries are divided into two categories, penetrating and closed. Bullets, shrapnel, rocks—anything that pierces the skull can wipe out brain matter or, by odd turns of physics, do little damage. Closed head injuries result from the force of a blast or a blow in which the skull remains intact but the brain, surrounded by fluid like an egg yolk, gets wrenched or slammed against the skull wall. Such sudden motion can squash brain cells and uproot axons, the rapid-fire, telephone wire-like tubes that connect brain cells. This effectively wrecks neural circuitry. Concussive forces may also rupture blood vessels in or around the brain, producing hematomas, or blood clots, that press on brain matter and, in some cases, kill it.

The physical destruction of brain matter or the disruption of brain cell communication can have profound effects. Injuries to the front of the brain are often worse, especially in closed head injuries. The back portion of the brain is better connected, more stable, than the frontal lobes. In the sudden shock of an IED blast, for example, the frontal lobes are more likely to be whipped against the skull, or rotate and tear axons. Because the frontal lobes control many aspects of memory, behavior, and motor function, severe damage can wipe out a patient's ability to solve problems, plan, speak, or control impulses.

One of the greatest challenges stemming from TBI manifests in what Dr. Warren Lux calls behavioral disregulation. Lux, a neurologist at Walter Reed, says cognitive problems—planning daily chores, pairing socks, solving problems—are often not as bad as the changes in emotional control and sexual behavior that occur. These shifts can scuttle marriages, alienate family, sever ties with former lives. In the worst cases, Lux says, TBI patients can become unpredictably violent.

MISSION: RESTORE

Head and limb injuries are the signature wounds of this war because Iraqi insurgents have made the IED their weapon of choice. Modern armor and rapid care mean that most of the injured survive, but many live with traumatic brain injuries and amputations.

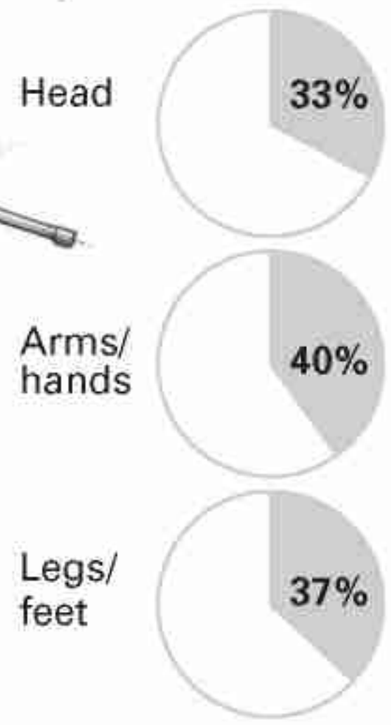
Armor

Kevlar helmet
Up to 40 percent more resistant to penetration than steel helmets.

Interceptor vest
Outer Kevlar vest and inch-thick ceramic inserts. Removable throat and groin protectors.

Vulnerable
Limbs, sides, and neck.

Where Injured



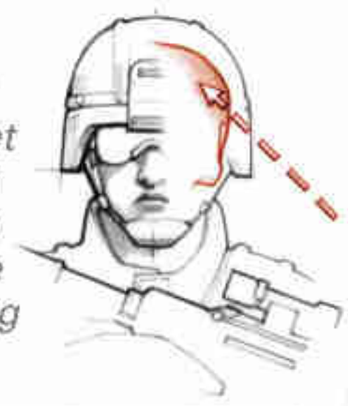
Most soldiers receive multiple injuries; totals add to more than 100 percent.

TRAUMATIC BRAIN INJURY (TBI)

Surgeons at Walter Reed Army Medical Center are rebuilding skulls with a new type of plastic implant that is stronger than bone.

CASE STUDY

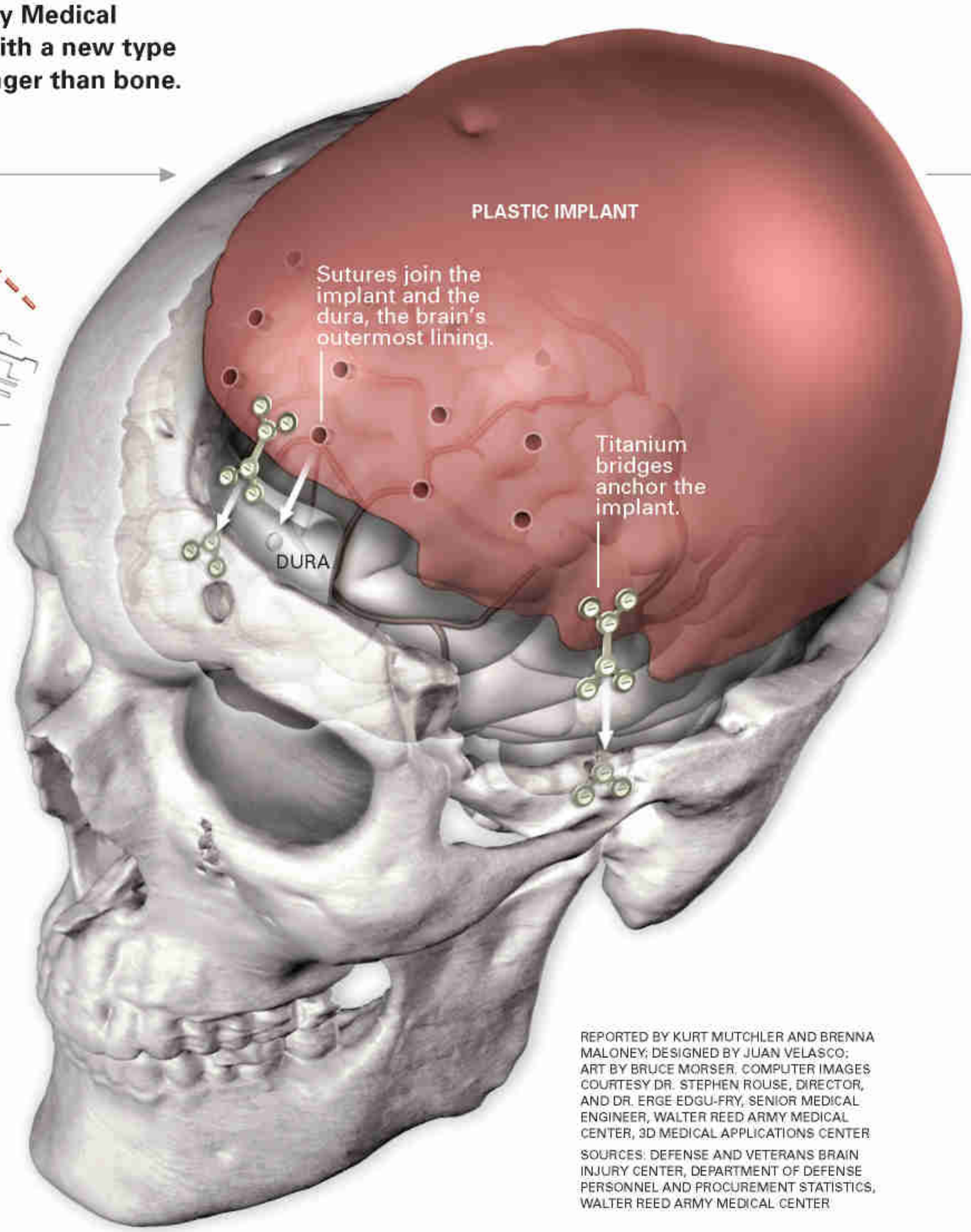
Fragments from a mortar punched through the helmet of this 22-year-old marine, shattering his skull above the left ear and lodging in his brain.



1 Battlefield surgeons removed a large piece of his skull to give his brain room to swell. While in a week-long coma, he was flown to the U.S. and spent months fighting infection and regaining strength.

2 This three-dimensional image of the soldier's skull was generated from CT scans. An epoxy resin model of the skull was then created to make a customized plastic implant and to guide surgeons as they fitted it over his brain four months after the injury.

3 More than six months after injury, he continues physical therapy, which includes learning how to walk again.



REPORTED BY KURT MUTCHLER AND BRENNA MALONEY; DESIGNED BY JUAN VELASCO; ART BY BRUCE MORSER. COMPUTER IMAGES COURTESY DR. STEPHEN ROUSE, DIRECTOR, AND DR. ERGE EDGU-FRY, SENIOR MEDICAL ENGINEER, WALTER REED ARMY MEDICAL CENTER, 3D MEDICAL APPLICATIONS CENTER

SOURCES: DEFENSE AND VETERANS BRAIN INJURY CENTER, DEPARTMENT OF DEFENSE PERSONNEL AND PROCUREMENT STATISTICS, WALTER REED ARMY MEDICAL CENTER

How Injured

11,995
IED (improvised explosive device)

2,852
Artillery, mortar, rocket

1,673
Gunshot

1,617
Weapons effect injuries (shrapnel wounds and others)

485
Other

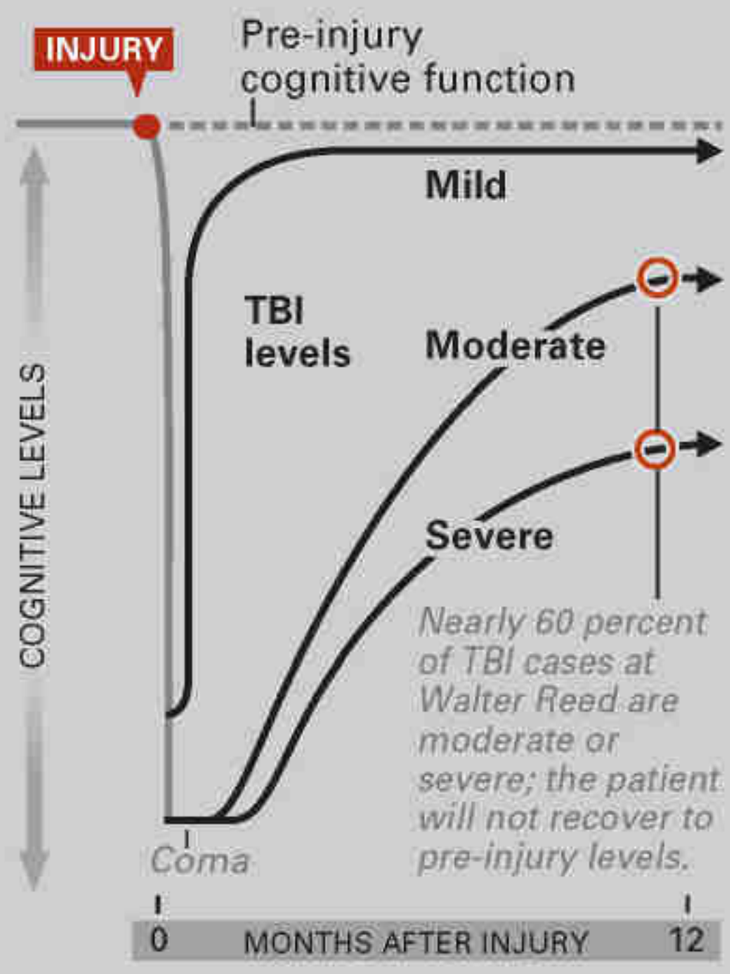
3,137
Cause unknown

U.S. totals, March 2003 to Sept. 15, 2006

Hidden Damage

Of 692 TBI patients at Walter Reed between January 2003 and April 2006, nearly 90 percent had non-penetrating head injuries —concussive wounds that may not be immediately apparent.

Expected levels of recovery



Impacts of TBI include reduced cognitive function, such as memory loss, and behavioral changes, including depression, anxiety, aggression, sleep disorders.

AMPUTATION

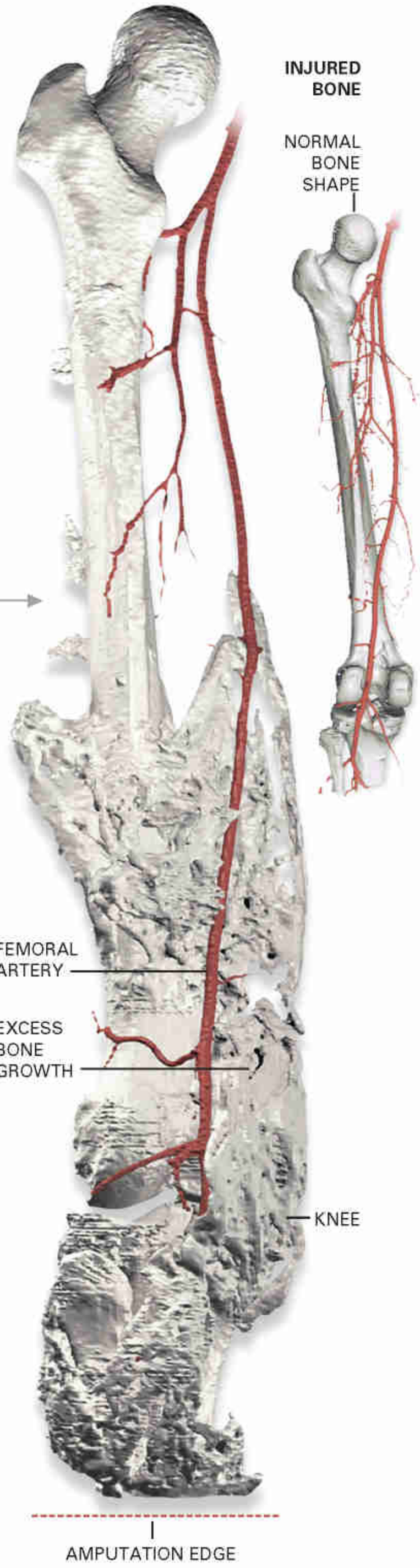
As of September 15, 2006, 468 soldiers have lost a limb; 78 have lost more than one. Perhaps because of the power of an IED blast, many amputees suffer a mysterious complication: abnormal bone growth called heterotopic ossification.

CASE STUDY

The left leg of a 38-year-old soldier was amputated below the knee after an IED attack caused open fractures and arterial bleeding.

1 Nearly half the amputees at Walter Reed have experienced heterotopic ossification —a rare and sometimes painful condition in which bone grows into areas where soft tissue has been shredded. After this soldier's amputation, healthy bone grew unchecked, trapping his femoral artery.

2 Surgeons waited months for the bone to stop growing. CT scans were turned into a 3-D image of the leg (right), then a model was made to guide surgeons so they could cut away excess bone without damaging the femoral artery. Radiation therapy followed to prevent the bone from growing back.



Another major problem, Lux says, centers on self-awareness. Many brain-injured patients don't recognize that they're injured or that they have lost pieces of themselves. "Part of what you need your frontal lobes for is to figure out who you are, because you need that to plan your way in life. Your self-image is built in your frontal lobes. That means that people who have all the skills to do things in the world won't use them because they don't know that they have to."

In the most common, and simple, form of brain injury, called a concussion, the brain usually regains normal function quickly. When it cannot self-repair, the brain sometimes rewires, routing signals along new channels, across its backup networks of axons. There are limits to this. The brain contains a finite number of axons. Brain matter, if it regenerates at all, grows very slowly. Repair takes time, weeks or months or even longer. Rehabilitation seems to work best when it occurs almost simultaneously, spurring the brain to form new connections, and the injured to learn new ways of thinking, acting, living. If rehab doesn't follow soon after injury, recovery is less likely to succeed; it may even become impossible.

Soldiers diagnosed with TBI proceed along separate paths depending on the severity of injury: mild, moderate, or severe. Moderate and severe patients are transferred to one of four special hospitals run by the Department of Veterans Affairs. There they receive long-term care and therapy. Patients with mild TBI may be sent home, back to duty, or, if they need additional rehabilitation, to community-based centers that focus on rebuilding their mental abilities. After nearly a month at Walter Reed, Jason Welsh was sent to Virginia NeuroCare, a small, private clinic in the rich green hills of central Virginia.

It is a Thursday morning in early August, and the merciless wet heat of a Virginia summer hangs over Charlottesville. The city is peaceful, collegiate, home to the University of Virginia, and close to Thomas Jefferson's home at Monticello. In the tangled brush, the overgrown forests, and stubbled fields nearby, tens of thousands died in Civil War battles at Fredericksburg, the Wilderness, and Chancellorsville. To reach Sgt. Jason Welsh, you must steer past them all.

Welsh sits in a small office, still wearing a neck brace, and tries to write a grocery list. An occupational therapist named Joy Sandlin helps him. He chooses food for a week of meals. But Welsh has never lived alone or cooked much for himself. Since his arrival at Virginia NeuroCare, he has lived in a group home with other brain-injured patients, some of them soldiers. His TBI has reduced his ability to focus and remember.

"Jason's going to need to learn to shop for himself and eat healthily," says Sandlin, a petite young woman with long black hair. "One of the things is that he's a 25-year-old guy who moved directly from his mom's house to the Army. He's never had to do this before, and he doesn't necessarily care. But it's something an adult needs to do, and the skills go way beyond breakfast." The exercise is one of planning, navigation, memory, and execution. Eventually, he'll travel to the grocery store using public transportation, remember why he's there and what he needs, and then gather and buy it. Simple tasks requiring a thousand minute computations.

Sandlin scans the list—ramen noodles, peanut butter, Honey Nut Cheerios. She asks questions, forcing Welsh to concentrate, probing his memory. She taps the list with her pen and says, "What do you think you'll want to drink besides Coke and milk?"

Welsh's injury was relatively mild. The MRI revealed "diffuse axonal injury"—shearing and twisting of axons—mainly in the right lobe, and some in the left. After the injury, portions of his brain had difficulty communicating, signals were interrupted, the network damaged. He has had problems with memory, multitasking. He loses focus, and sometimes his temper flares erratically. He curses more, and his sense of smell and touch have weakened. Welsh also suffers survivor's guilt, especially about Crombie. "I let him down," Welsh says. "I didn't even know him long enough to learn anything about his personal life."

Many brain-injured patients don't recognize that they're injured, or that they have lost pieces of themselves.

While talking, Welsh will pause, as if the current of thoughts had suddenly hit a dam. He searches for words. "Sometimes I have to stop and think. It's pretty embarrassing. I'm aware that it's not back yet. I can feel myself think slower, step by step, instead of just reacting. I hate it." Welsh spends hours each day working with therapists, developing ways to compensate for mental abilities that may take months to return, if they ever return at all. Still, through all of this, he has retained the major connections and patterns that form his personality.

TWO MONTHS AFTER HIS INJURY, Welsh is nearly ready to move into the clinic's independent apartment, where he will no longer be under 24-hour supervision. He has just been given a job at the nearby Judge Advocate General's Legal Center and School, which trains military lawyers. He'll wear his camouflage uniform, his sergeant's stripes. The job will help him practice social interaction and problem solving—some of the same skills the grocery shopping exercise focused on.

Welsh can't wait. He considers his injury a temporary setback. Returning to the infantry is all he wants, even if it means another tour in Iraq. "I feel like I've got a lot of leading left to do, a lot of teaching," he says. "Those guys in Iraq need experience, and I can give them that."

It's not clear yet whether the Army will allow Welsh to return to his old job. But his therapists have dedicated themselves to helping him progress as far as possible. One therapist describes Welsh as essentially normal, meaning he has regained, or developed compensations for, much of what he lost that night in Ramadi.

From the battlefield to the home front, Welsh has received the best medical care available anywhere, but his case reveals the limitations even of the massive military system. Early assessments missed his brain injury. And there are others like him. Many experts—including Dr. George Zitnay, who founded Virginia NeuroCare as well as Walter Reed's Defense and Veterans Brain Injury Center—have pressed the Department of Defense to screen returning veterans for brain injuries. The department has only recently begun limited screening.

Welsh's mother, Lynne, visits him for several days in Charlottesville to check on his recovery. One evening, over burgers and iced tea at a restaurant in a local strip mall, Lynne reminisces with Jason about his years as a headstrong kid with a mischievous streak and a disdain for authority. Her voice is raspy and midwestern. The pair joke and laugh, remembering. For Lynne Welsh, the fear is fading. She knows she's fortunate, watching the old Jason reemerge. She knows that many soldiers never do.

After dinner, mother and son sit together outside Welsh's room in the group home, a large, white house with a small yard and a wraparound front porch. Welsh burns to leave, but he can't yet. His neck hasn't healed, and last night he exploded when a staff member tried to order him to bed. He felt ashamed afterward, unsure why he did it. Maybe it was the sleeping pills, maybe the brain injury. He unfastens his neck brace, demonstrating how in anger he hurled it across the room. He catches a whiff of the sweat that had soaked it during the stifling summer days.

"God, I've gotta wash this thing," he says, a little embarrassed. He is less the sergeant in his mother's presence, more the kid who loved cars and used to ditch school and circle town in a big Chevy Blazer. Lynne Welsh looks him over.

"I'm just glad it's him," she says. "The important thing is that Jason *is* Jason."

Jason smiles, lines breaking at the corners of his eyes, dispelling for a moment the boyishness.

"For the most part," he says. □

On the front lines U.S. military medics in Iraq describe their experiences at **ngm.com/0612.**

The lure of such fabulous artifacts as the solid gold mask of a fifth-century B.C. Thracian king inspires both legal and illegal excavators.

PHOTOGRAPHED AT NATIONAL ARCHAEOLOGICAL MUSEUM, SOFIA

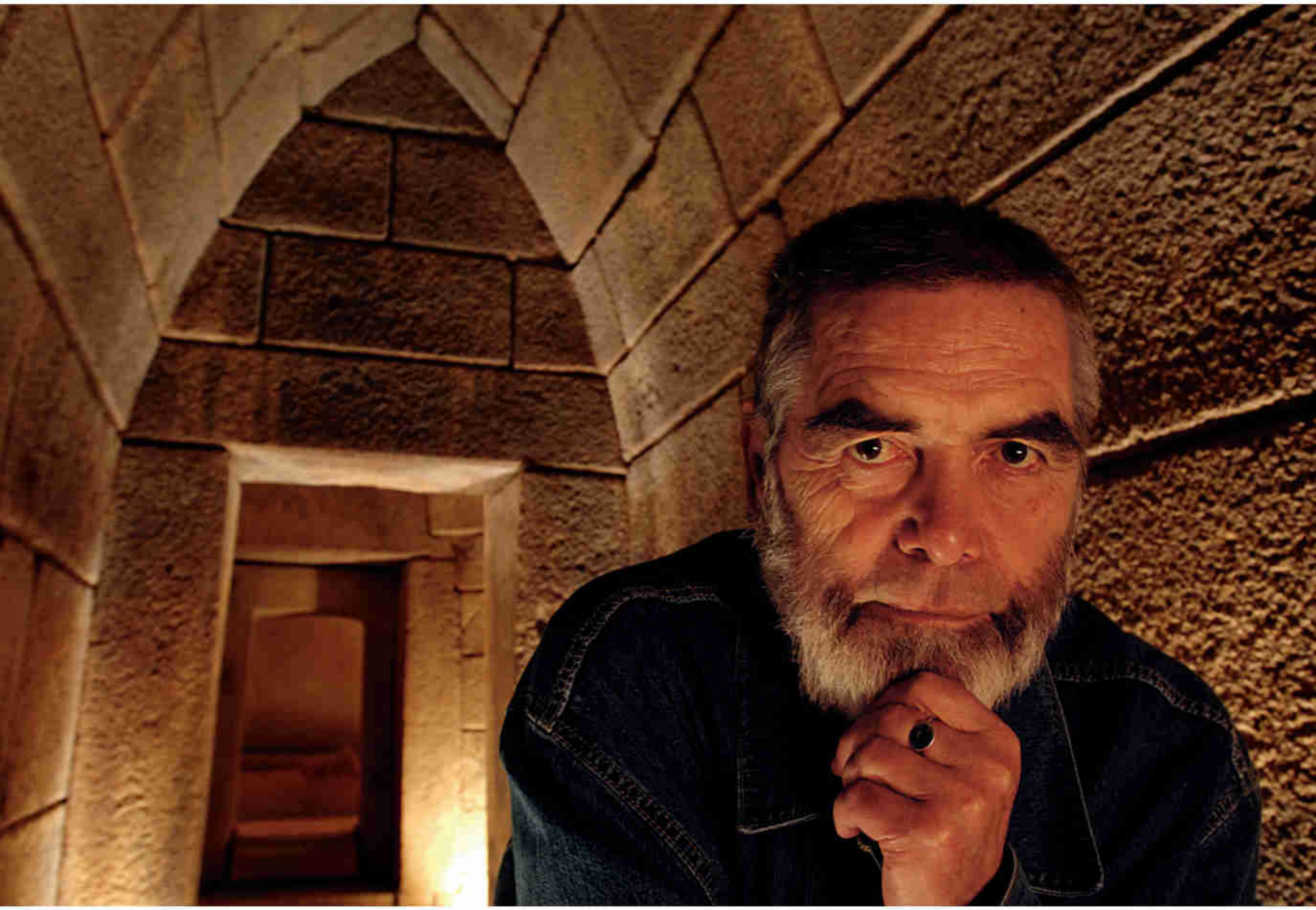
Bulgaria's Gold Rush

Looters are digging for buried treasure, while developers covet the land itself.

By A. R. Williams *Photographs by Kenneth Garrett*

NATIONAL GEOGRAPHIC STAFF

Archaeologist Georgi Kitov works fast. Using backhoes and bulldozers to uncover the stone tombs of ancient Thracian rulers, he can accomplish in a week what a more careful, conventional excavation would spend many months doing by hand. He has no choice, he explains. Looters are everywhere, ready to rip into sites. "They have more money than I do and better machines," Kitov says. "I'm trying to save what they want to destroy, and I think I've been very successful. I've stopped a lot of them."



Kitov is controversial, though—a hero to some, a villain to others. Now 63, he learned about digging by machine early in his career, studying the method used by his Soviet colleagues and quickly becoming a convert. "I think it's wasting time to work only by hand," he says. But his haste and lack of precision disturb many of his colleagues. Some bluntly accuse him of being a treasure hunter. Others call him a media archaeologist, a showman who spins tales about his discoveries for the press. But his defenders point out that almost half the excavated gold and silver artifacts in Bulgaria's biggest museums came from Kitov's sites—stunning necklaces and earrings, classically shaped cups with graceful handles, bowls and pitchers, rosettes from horses' harnesses, ornaments from a warrior's armor, beautifully embossed shin guards, a crown of delicate oak leaves, a king's gleaming mask. If Kitov hadn't found them, looters most surely would have.

For looters, Bulgaria is El Dorado, a vast trove of buried treasure where some graves have harbored gold since at least 4000 B.C. Through the sweep of many centuries, this strategic bridge between Asia and western Europe saw a long succession of invaders, conquerors, soldiers, travelers, traders, and settlers. Thracians, Macedonians, Greeks, Romans, Persians, Slavs, Bulgars, Byzantines, and Turks all made their mark—and left artifacts that now mean money in the bank for anyone who succeeds in digging them up.

The royal tombs of the Thracians, built between the fifth and third centuries B.C., are easy marks for looters. The great overgrown beehive mounds of the tombs rise several stories high along roads and in tilled fields. In the 50-mile-long Kazanluk Valley, where Kitov works, a thousand such mounds interrupt the rose farms that bloom beneath the peaks of the Sredna Gora and Balkan Mountains. Some 25,000 more mounds are

Georgi Kitov (opposite) counts the grave of third-century B.C. Thracian king Seuthes III —entered through a vaulted stone hall—as one of his many finds in the Kazanluk Valley. Another royal tomb near Zlatinitsa yielded a goddess-shaped shin guard (right).

PHOTOGRAPHED AT NATIONAL MUSEUM OF HISTORY, SOFIA

Kitov's haste and lack of precision disturb many of his colleagues. Some bluntly accuse him of being a treasure hunter.

As a metal detector scans for riches, Kitov, in the rear at right, inspects a trench dug into a Thracian mound by machine. The team found nothing, but the mound had probably covered a ritual platform.

In a few days of digging, Kitov's team put a trench through a ritual mound near Kazanluk (below). Countless sites in Thracian lands (map, right) have yet to be excavated.

scattered throughout the rest of the country. Many show the fresh scars of illegal excavations —jagged trenches of rusty earth that cut through their tangled cover of grass and brush. Sometimes the looters break into a tomb that was already robbed in antiquity. And sometimes, instead of gold or silver, they find painted vases or bronze sculptures or fragments of murals—any of those things will earn a handsome profit on the antiquities market.

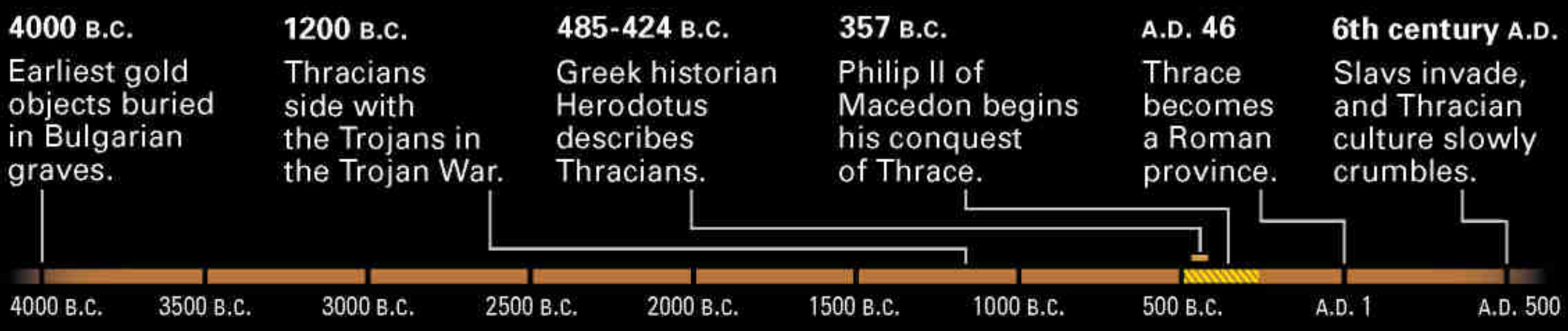
Ancient treasures are property of the state in Bulgaria, and that was once taken very seriously. In 1949 three brothers digging clay for tiles near the town of Panagyurishte uncovered nine ornate vessels of solid gold, buried for more than 2,000 years. The country had fallen under the Soviet heel only a few years before, and the new totalitarian state dealt brutally with anyone who broke the law, so the brothers dutifully turned their find over to the authorities. Back then, no one needed to run the risk of trying to sell such a windfall. Factories that produced everything from canned fruit to Kalashnikovs guaranteed full employment, and the government took care of everything else. So in 1985, when a villager in Rogozen hit a cache of 165 silver and gold vessels while working in his vegetable garden, he too handed the priceless hoard over. Both of these treasures now rest safely in museums.

Would that happen today? Probably not. When the Soviet system began to crash in 1989, it took Bulgaria down, too. Factories were forced to close, and to this day many remain empty. Hundreds of thousands of people are still unemployed, and those who have jobs earn an average of just $200 a month. With the former middle class flat broke,

MAP BY CHARLES W. BERRY AND GUS PLATIS, NGM MAPS

Who were the Thracians?

The many tribes of ancient Thrace, which stretched across modern Bulgaria (map, facing page) and beyond, were related by language and culture but rarely united politically. Their own narratives—probably oral and perhaps sung—have been lost, and only fragments of their history survive in Greek and Roman texts. Feared warriors and skilled horsemen, they fought in the Trojan War against the Greeks. Centuries later, at the height of their power, they buried their rulers beneath grand stone domes such as the tomb recently discovered at Alexandrovo (above). After Philip II of Macedon conquered Thrace, its archers and cavalry were conscripted into the army of his son and heir, Alexander the Great. In 73 B.C., one Thracian gained immortality by leading a slave revolt against the Romans—the gladiator known as Spartacus.



For looters, Bulgaria is El Dorado,
a vast trove of buried treasure
where some graves have harbored
gold since 4000 B.C.

Adorned with mythical figures, a stag's-head drinking vessel belongs to a kingly hoard uncovered near Panagyurishte.

PHOTOGRAPHED AT NATIONAL MUSEUM OF HISTORY,
ON LOAN FROM ARCHAEOLOGICAL MUSEUM, PLOVDIV

many have taken up looting to earn a living. They call it black archaeology. "The business of artifacts is more lucrative than drug trafficking," says Nikolai Ovcharov, a charismatic archaeologist known as Bulgaria's Indiana Jones. An exaggeration? Perhaps. But there's a lot to gain, and the authorities are in on it. Everyone knows a story. A mayor, picnicking with friends and family in the countryside, pokes around to see what he can find. Looters, arrested while digging, include policemen who parked their cruiser right beside the trench. Ancient coins and jewelry worth several million dollars disappear from a museum, almost certainly an inside job.

Small pieces often land in the street bazaar in downtown Sofia, displayed on folding tables beside old typewriters, World War II medals, and Beatles albums. "It's just 50 meters from parliament," says Ovcharov in exasperation. "I've seen pieces of a Thracian chariot for sale, coins, clasps. They're not forgeries. They're all original."

Valuable pieces—the precious metals and carved stones and decorated ceramics that rise to the level of art—sometimes move quietly to the wealthy few, Bulgarian collectors who can afford to buy such things in cash, no questions asked. Rumor has it that the collectors commission looters to find things, and the looters have connections to organized crime. But these are illegal transactions involving men who are armed and dangerous, and no one has details—or is willing to share them. At least the artifacts stay in the country, and if amnesty is ever declared for collections acquired on the sly, they could be displayed in museums here for everyone to enjoy.

The darkest part of this shadowy business is the international smuggling. "The best artifacts leave Bulgaria," says Ovcharov. "Vienna. London. Zürich. Everybody knows the connections. I recently visited an antique store in Berlin that was full of Thracian artifacts." How much plunder is leaving the country is anyone's guess, but by most estimates Bulgaria has become Europe's top exporter of illegal antiquities.

That's devastating news to a people who feel intimately connected to their ancient past. History surrounds them everywhere, since modern

Symbols of life's decay and renewal, statues of women old and young surround a Thracian king's tomb, found at Sveshtari. In the Rhodope Mountains of southern Bulgaria, archaeologist Nikolai Ovcharov (bottom) studies Perperikon, a religious center from prehistoric to Byzantine times.

homogenized architecture hasn't yet slicked up their country. Under everything, everywhere, lie deep layers of history that have built up through thousands of years, and any digging hits something old. A tunnel for Sofia's subway, for instance, uncovered a section of a Roman brick wall. Now it's a mini-museum in an underground mezzanine. In this part of the world—in the Balkan States, where countries have been carved up and borders disputed so often—such visible evidence of history is important. It establishes roots, a claim to the land. Every city, every town in Bulgaria has a museum filled with artifacts excavated right there, not imported from elsewhere. And every weekend Bulgarians of every age, gender, and economic level turn out to have a look.

"Even in the poorest years, when we were starving after the 'democratic changes' in 1989, this museum had visitors," says Bojidar Dimitrov, who heads the National Museum of History in Sofia. Today, he works the gate like a business. "I want gold and silver artifacts here to attract the crowds," he says. Part Soviet dictator, part free-market capitalist with a dash of P. T. Barnum, he funds archaeologists, they find artifacts, and more people come. In August 2004, a normal vacation month, the museum had 7,000 visitors. One year later, with newly discovered gold from a Thracian tomb on display, it had 68,000. That, multiplied by an average ticket price of five leva, or a bit more than three dollars, brings in a nice sum of money. It's much needed. "After 1989 the state had no money for excavations," Dimitrov explains. "But after several years in shock, we began to find our way through this new system."

On the other side of the balance sheet are the archaeologists, who now have to find support for their work. Most deal with unglamorous things—stones and bones and plain pottery—and for

that they might cobble together a year's funding of $10,000 or so. But someone who makes dazzling discoveries again and again can do much better. Kitov, for example. In a good year, he might get the equivalent of $65,000 from a foreign foundation, $30,000 from a Bulgarian business, and $20,000 from Dimitrov—totaling $115,000. In this new equation, eager sponsors plus the problem of looters add up to a double load of pressure. Which is why he works so fast.

Kitov doesn't have much time, or patience, for interviews. "I only agreed to talk to you because of the Thracians," he says. "I want the world to know that there were such a people, and that they were great." What he and his colleagues are discovering about this little-known culture is changing the history of the ancient world. Classical Greek authors described their neighbors to the north as barbarians. But Dionysus, worshipped by the Greeks as the god of wine and good times, was originally Thracian. And Orpheus, a hero and musician in Greek legend, came from Thrace too. Clearly the barbarians had traditions worth borrowing, and as the archaeological record is revealing, they had wealth and power and art as well.

"We're seeing that our culture was just as good as the Greeks' and the Italians'," says Ovcharov. And in that fact lies a golden opportunity: Ancient ruins and artifacts help attract tourists. Add the sun and sand of the Black Sea coast and Bulgaria's upcoming entry into the European Union, and suddenly this largely underrated land of antiquity is becoming a hot destination. In every town from Varna to Sozopol, new condos, townhomes, and villas painted in candy pastels stand shoulder to shoulder and blocks deep along the shore. Steel cranes perch over the growing frames of sprawling luxury complexes. Billboards advertise properties in English and German, selling sybaritic dreams. A two-bedroom apartment can be had for $170,000. A remodeled house on a historic cobblestone street might cost $700,000. With much of the

Armed with a spear and bow—classic Thracian weaponry—a warrior gallops across a harness decoration of silver and gold.

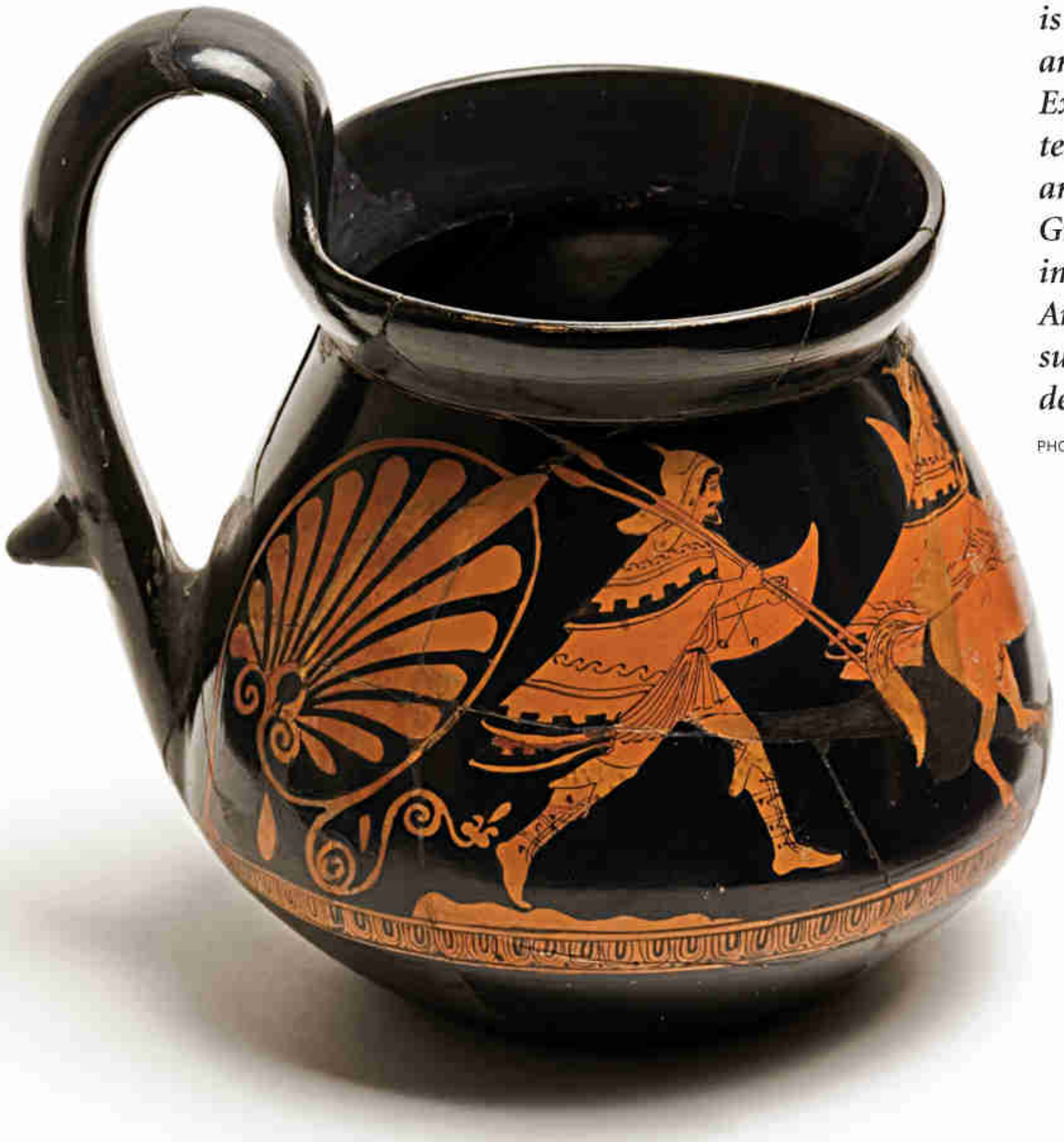
PHOTOGRAPHED AT NATIONAL MUSEUM OF HISTORY, ON LOAN FROM MUSEUM OF HISTORY, LOVECH

coast still pristine, and fortunes to be made, the real estate boom is just beginning.

That's mixed news for archaeologists. By law, sites with any artifacts have to be studied before building can start, so there's lots of work. But with so much construction going on, the archaeologists are overwhelmed. Suntanned and tired, Dimitar Nedev, director of the archaeological museum in Sozopol, works with a team trying to keep up with the permits that have been issued for building along the beach. With a month, maybe six weeks, to finish each site, they're in a hurry, and like Kitov they use a bulldozer along with the usual shovels, trowels, and soft brushes. Their goal is the same as Kitov's as well, Nedev says. "We're all trying to save what we can."

Grave by grave along Sozopol's coast, the archaeologists are uncovering the three-mile-long cemetery of a Greek trading colony founded in Thracian territory in 610 B.C. In an area where simple rectangular graves were dug into the sandy soil, they find a skeleton with a bronze pin at the shoulder and a few pieces of pottery clustered above the head. No great treasure, but it adds its unique details to the emerging history of the colony—a key element in the future of Sozopol. "The only way we can sustain tourism here is through our cultural heritage," says Nedev. And so he collects each artifact, building the story of Greek colonists surrounded by a tribe of fierce Thracian horsemen—a story that will help bolster the region's economy for generations to come.

This modest part of the cemetery is doomed. Once the contents of the graves have been removed, construction will start. "Another beautiful building," jokes an archaeologist with a



Along the Black Sea, in what is now the port of Sozopol, ancient cultures once mingled. Excavations at a seaside cemetery have uncovered skeletons and artifacts, including a Greek-style pitcher with the image of a Thracian warrior. Archaeologists are racing to save such pieces of history as resort developers invade the area.

PHOTOGRAPHED AT ARCHAEOLOGICAL MUSEUM, SOZOPOL

grand sweep of her hand. To one side, on a plot where the team worked last season, stands a mansion, now occupied. Behind the cemetery lie a turquoise swimming pool and townhomes draped with for-sale banners. In front, brick walls rise amid the fitful din of hammers and buzz saws. But a mile down the beach an excavated section of the cemetery was left for tourists to see on their walks along the crescent bay. Freed of the tan sand, two low walls of stone mark the parallel sides of the ancient Greek coastal road. Neat stone borders of graves rest on each side, and part of the ancient water main—large clay pipes clamped together with lead—runs nearby.

Overlooking this vignette of early engineering stand the bare bones of a building: two floors of rough concrete, bark-covered poles supporting the roof, steel rebar bristling from the top. The owner is a retired soldier named Lubomir Jenov, who is building a guesthouse little by little as his daughter brings money home from her job on a cruise ship. Two years ago archaeologists excavated here and found only simple graves, so Jenov was free to begin his project. "I'm doing this for my grandchildren," he says, "so they'll have a small business when Sozopol is a big tourist town." He says he hopes that entry into the EU will bring more visitors. But he shrugs, as if he can't quite believe things will turn out well after the hardships his country has struggled with in recent decades. He's got grandchildren, though, and a stake in the future, so he has to hope—and keep building. □

Gallery See more Ken Garrett images of Bulgaria and its Thracian treasures and browse through a listing of related links and resources at **ngm.com.**

Sail six days southeast from the tip of South America through latitudes called the furious fifties and you strike the South Sandwich Islands, guarded by blue icebergs, millions of penguins, and an unforgiving sea.

Photographs by Maria Stenzel

Underworld

Preceding pages: Chinstrap penguins ride an eroded iceberg near Candlemas Island.

An exposed slope on Thule Island draws chinstrap penguins from November into March. Nesting adults alternate fetching food for their chicks; the birds head north during winter's worst.

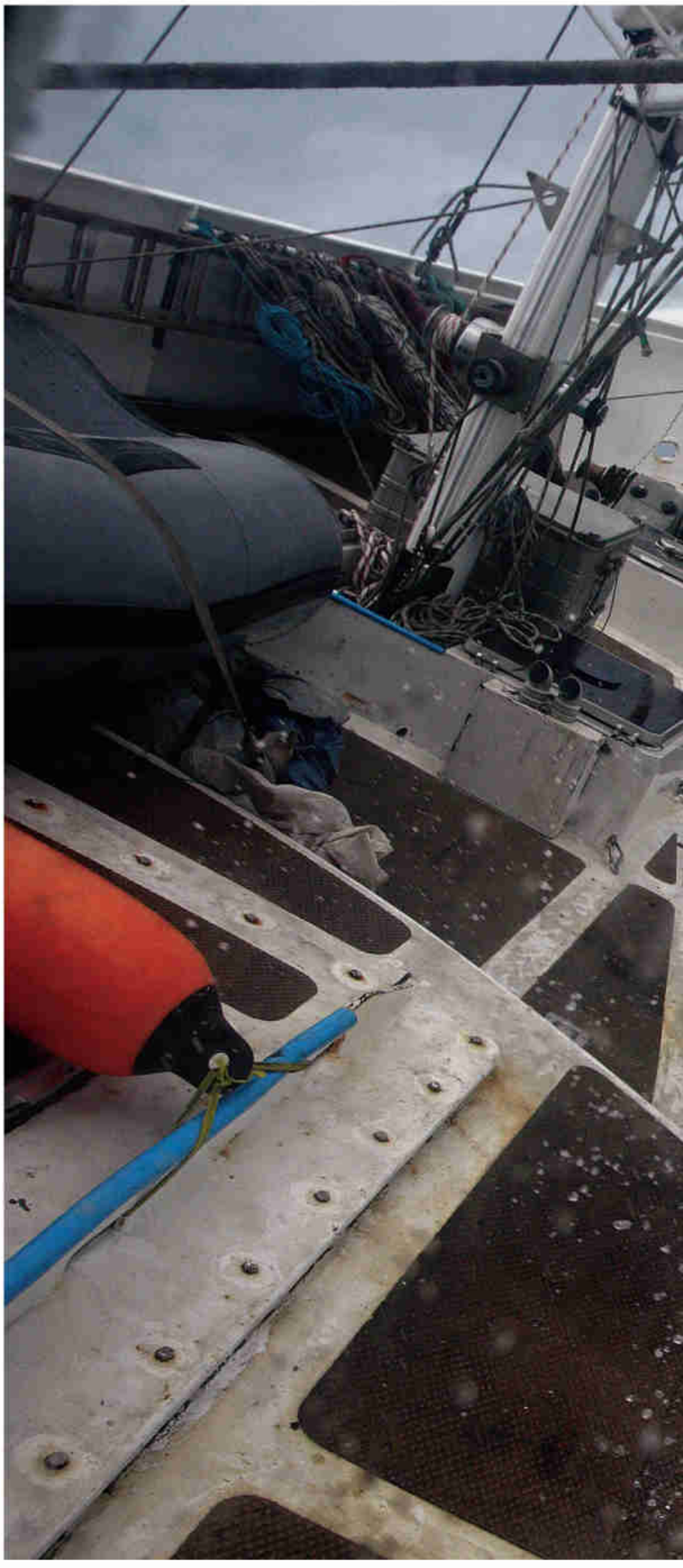
The South Sandwich Islands are nature's solo act. Volcanic eruptions roughed out their shape; ice, wind, and waves hammer and carve them. Birds and seals alone find refuge here. Captain James Cook, on his search for a rumored southern continent, discovered the islands in 1775. Confronted by "Thick fogs, Snow storms, Intense Cold and every other thing that can render Navigation dangerous," he quickly tired of the region and, without apology, left the South Sandwich Islands behind forever.

But what repelled Cook is what makes the 240-mile arc of 11 islands extraordinary. Isolation. Exposure to the Southern Ocean's furious moods. Pack ice that holds the islands in a vise grip most of the year. The roar from crowded bird colonies and the reek of their guts and waste coating rock and ice. Exploding waves that beat surfing penguins bloody against the cliffs and block ships from shore. And beneath it all, one of the Earth's fastest moving tectonic plates keeps the young volcanic archipelago—only some three million years old—expressive and unpredictable. "The place has a pulse," says photographer Maria Stenzel. "It's spooky and spiritual and immensely powerful."

Yet so few have been here. After Cook named the islands for the fourth Earl of Sandwich and fled, nearly 45 years passed before Russian explorer Fabian von Bellingshausen battled sleet squalls to discover the three northerly islands his predecessor had missed. Commercial sealers and whalers hunted the area in the 19th and early 20th centuries but found their task less daunting elsewhere. So they, too, went away.

Unlike the well-traveled Antarctic Peninsula, the islands see no tourism, and even intrepid volcanologists rely mainly on aerial surveys to study them. There's only a four-month window for a boat to dodge the hull-crushing pack ice, and few sailors are up to the task.

Then there's Jérôme Poncet. The veteran Antarctic sailor has been testing himself against the Southern Ocean for three decades. In the late



"These difficulties are greatly heightned by the enexpressable horrid aspect of the Country."

CAPTAIN JAMES COOK, 1775

Golden Fleece **pounds the Scotia Sea between the South Sandwich Islands and the Falklands—a stretch of 1,100 nautical miles reserved for the heartiest of sailors, like the yacht's captain, Jérôme Poncet.**

"A thick stinking vapour was continually rising [like] smoke from the funnel of a steamer."

RUSSIAN EXPLORER FABIAN VON BELLINGSHAUSEN, 1819

1990s he lent his skills to making detailed bird and seal counts on the South Sandwich Islands.

He documented mind-blowing numbers of animals on those journeys. Penguins, most obviously: three million chinstraps, more than 52,000 pairs of macaronis, 50,000 pairs of Adélies, and thousands of gentoos. Plus the soaring seabirds: 1,500 pairs of southern giant petrels on tiny Candlemas Island alone; 100,000 pairs of Antarctic fulmars; Cape, snow, and storm petrels; shags, skuas, gulls, and terns. And the seals: fur seals (with some 500 pups on Zavodovski), leopard, southern elephant, crabeater, and Weddell—all nourished by the Southern Ocean's krill-based food chain.

Piloting his 65-foot steel-hulled yacht, *Golden Fleece,* the sun-creased and thickly mustached Poncet is one of the few sailors audacious enough to sail to the South Sandwich Islands—a place he admits can offer "nowhere to hide, no safe mooring, just ice and sea and big waves and a pessimistic forecast." Setting out from the Falklands with Maria Stenzel and a crew of four, he skirted icebergs and bucked foul weather last January for a three-week survey down the island chain, a territory of the United Kingdom (also claimed by Argentina).

Getting onto islands so barricaded by wave surges and sharp walls is a jaw-clenching prospect. But Poncet eyes each coastline for a way to shore, and usually finds it. Piling crew and gear into an inflatable Zodiac, "Jérôme would time it so we'd ride the swell in," says Stenzel. "Then he'd gun the engine and pin the bow against the cliff face as we leaped to land before the wave, and the boat, fell from under us."

On Zavodovski, chinstraps let Stenzel walk their worn paths and sit among the growing colony. Each morning they filed past her tent to the sea like rush-hour commuters, then again on their return—battle-weary soldiers, dirty or bloodied from surfing waves into rocks or from near misses with predators. Knock-down 60-knot winds and squalls replaced bright sun in minutes, and it once rained for 24 hours, turning dry gullies into rushing streams. Sudden rivers and waterfalls whisked penguin eggs out of shallow, pebble-lined nests. "They're so vulnerable," says Stenzel, "always on the edge of disaster."

Next landing: Visokoi, more than 3,000 feet tall, where sun-warmed cliff faces sloughed boulders, sending everyone diving for cover. Candlemas Island was black with volcanic slag and alive with nesting southern giant petrels—birds now closely monitored throughout their range. With a six-foot wingspan, they spend most of their lives far out at sea and are being killed off as bycatch from longline fishing. "They whooshed over us like cars passing too close to a pedestrian," says Stenzel. "It was exhilarating."

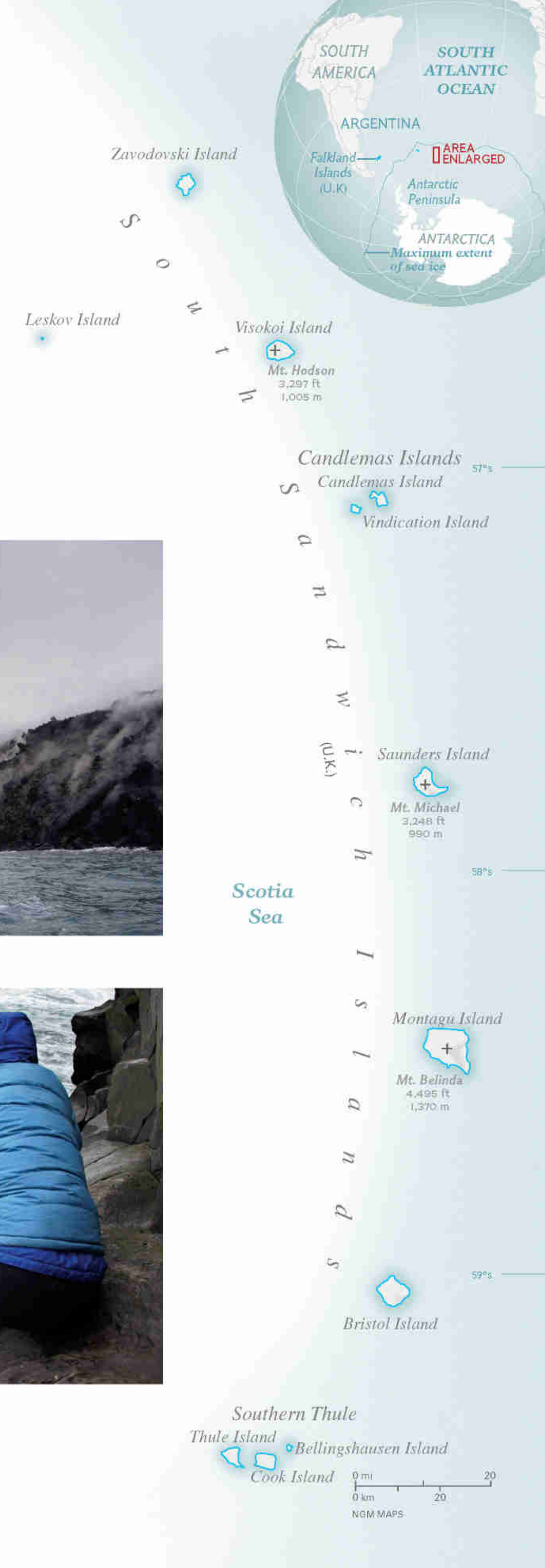
Recently flowing lava had hardened into a new slice of land on Montagu, where *Golden Fleece* waited out a storm. Off Bellingshausen, penguins blocked by brash ice evoked pool balls colliding as they tried vainly to escape the jaws of leopard seals. Thule Island houses a rare sign of humans: a wrecked Argentine base from the Falkland Islands war. Nature's mark is snow algae streaking glacial ice with exquisite reds and greens. A hike on Cook Island revealed black lightning bolts of magma that had oozed through cracks in boulders, and gull-like fulmars nesting so profusely on the cliff tops that they resembled snow. "Everything," says crewman Oren Tal, "is alive."

In their remoteness, the shape-shifting islands hold their stories close, and the few souls who have felt the pulse of the South Sandwich Islands' volcanic energy and abounding wildlife consider it a privilege. "Living in deep communication with this place, you feel changes in yourself," says Poncet. "Every trip brings something new."

—Jennifer S. Holland
NATIONAL GEOGRAPHIC STAFF

Southern Exposure Watch video of photographer Maria Stenzel's South Sandwich journey and find Web-exclusive images at **ngm.com/0612.**

The archipelago's gentle arc marks a volcano-building juncture of tectonic plates. Banks of newly hardened lava, poured from the crater on Montagu Island, steam behind *Golden Fleece* (below). Crumbling cliffs and unrelenting surges make landing on Zavodovski Island perilous (bottom). One attempt put two men overboard.



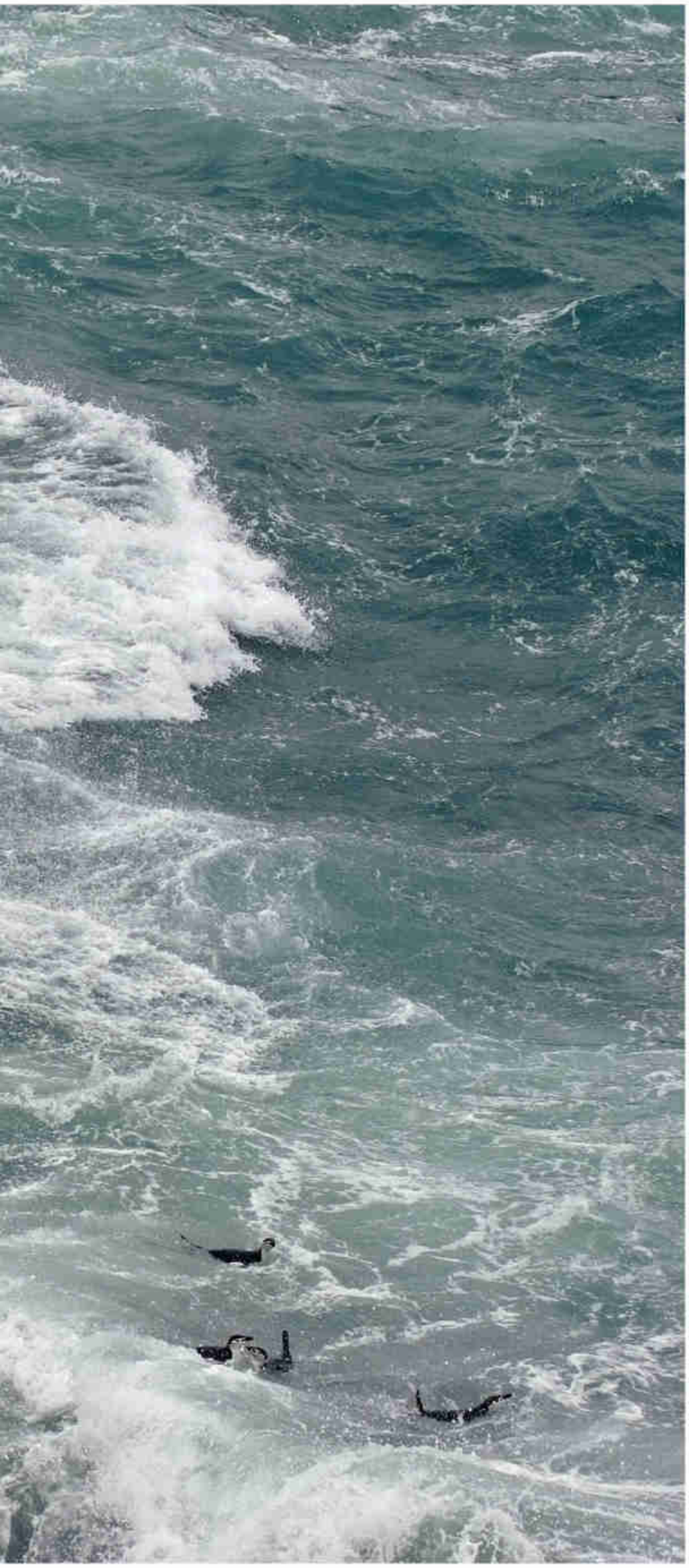
Ash from Mount Belinda stains a penguin-flecked iceberg off Montagu. Volcanic coughs gave way to gushing lava in 2005, which so far has added a hundred acres of new land to the otherwise icy terrain.

Steam drapes the cliffs on Bellingshausen as waves eat away at rock born from the crater's fire. Stoking that inferno, one of Earth's fastest tectonic plates moves below the islands nearly three inches a year.

Cliff-diving chinstraps hazard seething waters and predatory leopard seals off Zavodovski. Most survive the pummeling to head offshore and fill up on krill that they later regurgitate for ravenous chicks.

"They are a strange fowle, or rather a miscellaneous creature, of Beast, Bird and Fish."

FRENCH NATURALIST PIERRE SONNERAT, 1776



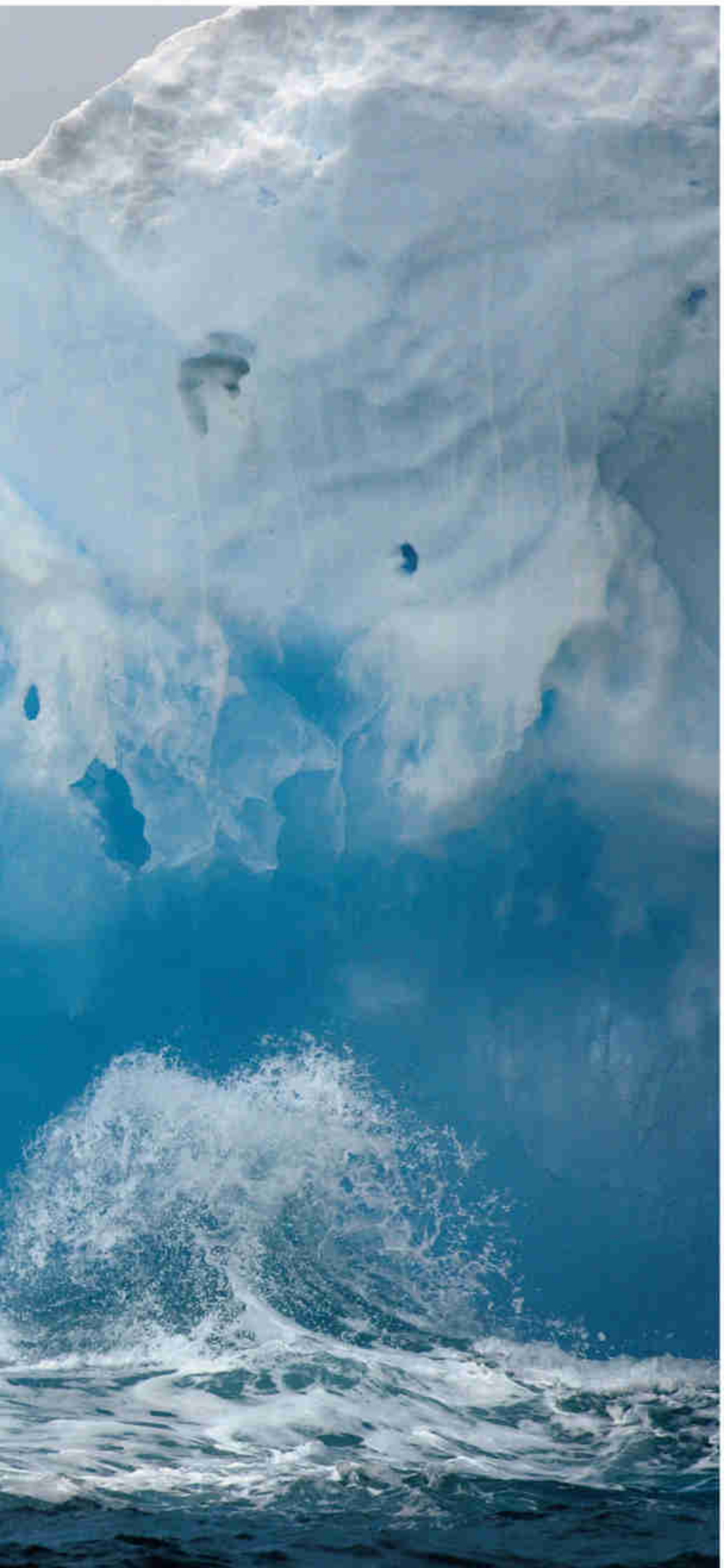
An algae-marbled slab towers 300 feet on Thule Island, where glacial ice persists. For their steep scrambles and long marches between colonies and the sea, chinstraps earned the nickname “mountaineers.”

It may be the largest, loudest, most pungent colony on Earth: Two million chinstraps amass to breed on Zavodovski each austral summer. “They are entirely dedicated to reproduction,” says Poncet.

A blue-ice porthole seems to peer onto clouds. South Sandwich is rich with blue bergs—old and very dense ice shaped by ocean, sun, and time. Says crewman Oren Tal, "They set your imagination free." □

"A Country doomed by Nature . . . to lie for ever buried under everlasting snow and ice."

CAPTAIN JAMES COOK, 1775



The Ghost Bird

It lives! say experienced observers, who claim seven convincing sightings of an ivory-billed woodpecker since 2004 in Arkansas. Even as new reports turn up, skeptics doubt that the legendary Lord God Bird has managed to elude extinction since the last confirmed U.S. sighting in 1944.

Male specimen collected around 1900

UNIVERSITY OF NEBRASKA STATE MUSEUM

As spring approached, the ivorybill team led by the Cornell Laboratory of Ornithology kept watch.

Some 20 biologists and 100 volunteers searched eastern Arkansas from November 2005 to April 2006.

BY MEL WHITE

PHOTOGRAPHS BY JOEL SARTORE

I can testify that at 7:30 a.m. on March 16, 2006, there was no ivory-billed woodpecker at latitude 34°6′48″, longitude 91°7′43″, deep in the spring-greening woods of Arkansas's White River National Wildlife Refuge. A straightforward enough observation, you might think—but you'd be wrong. When it comes to the Lord God Bird, even the simplest statement invites equivocation and argument.

I was one of about 50 people participating in a "saturation search" of an area where biologists from the Cornell Laboratory of Ornithology (CLO) thought an ivorybill might be present. As I sat quietly on a log with my binoculars and camera ready, listening to morning birdsong, I knew some would say that the entire effort was futile and even nonsensical—that the reason neither I nor anyone else would see an ivorybill was that the last one in the U.S. died a lonely death decades ago, leaving only sad, dried, eyeless skins resting in the ornithological morgues of museum trays.

The ivorybill faithful, on the other hand, have another explanation. They say the bird, in its 21st-century incarnation, has been transformed into a creature as shy as Bambi, as silent as a Trappist monk, as anxious to avoid photographers as a Mafia stool pigeon in a witness-protection program—altogether as invisible to the human senses as a stealth fighter is to radar.

So: I feel strongly that no ivorybill was present at the above time and location, but I could be wrong.

Get used to that kind of sentence, because today's lesson is all about conjunctions and adverbs: *but, though, however, unless, possibly, nonetheless,* and, of course, *maybe.* Especially *maybe.*

TWO MONTHS LATER and 40 miles to the north, Ron Rohrbaugh of the CLO stood on the lawn under the clock tower of the Monroe County courthouse, addressing a small crowd sheltered from the midday sun under tents provided by a

"IVORYBILL BURGERS" top the menu at Gene's Bar-B-Que and Restaurant in Brinkley, Arkansas—Ivorybill Central. The reported sightings put the town on the map, and the curious have come from around the world to see what they can see.

local funeral home. He was there to announce the results of a six-month search for the ivory-billed woodpecker in the area of eastern Arkansas known as the Big Woods, a half-million-acre expanse of forest and wetlands centered on the White River. The effort involved some 20 field biologists and more than a hundred carefully selected volunteers, as well as remote audio recorders, automatic cameras, GPS-based computer mapping, and all the other high-tech gizmos that the team had assembled with its million-dollar budget.

Rohrbaugh thanked the people of eastern Arkansas for their hospitality, reviewed past research, and listed some "interesting" and "intriguing" possible sightings that unfortunately "don't add any additional confirmation." All this might have been summed up in a pithy phrase his colleague Elliott Swarthout had used a few days earlier. "We're going to present exactly what we found this season," Swarthout said, "and that ain't squat."

It was a long way, literally and figuratively, from the scene a year earlier when, on April 28, 2005, CLO director John Fitzpatrick stood on a stage in Washington, D.C., along with the secretaries of the Interior and Agriculture Departments and two senators, to announce that a secret Cornell-led search team had confirmed the existence of an ivory-billed woodpecker flitting elusively through the tupelos along a small Arkansas stream called Bayou DeView.

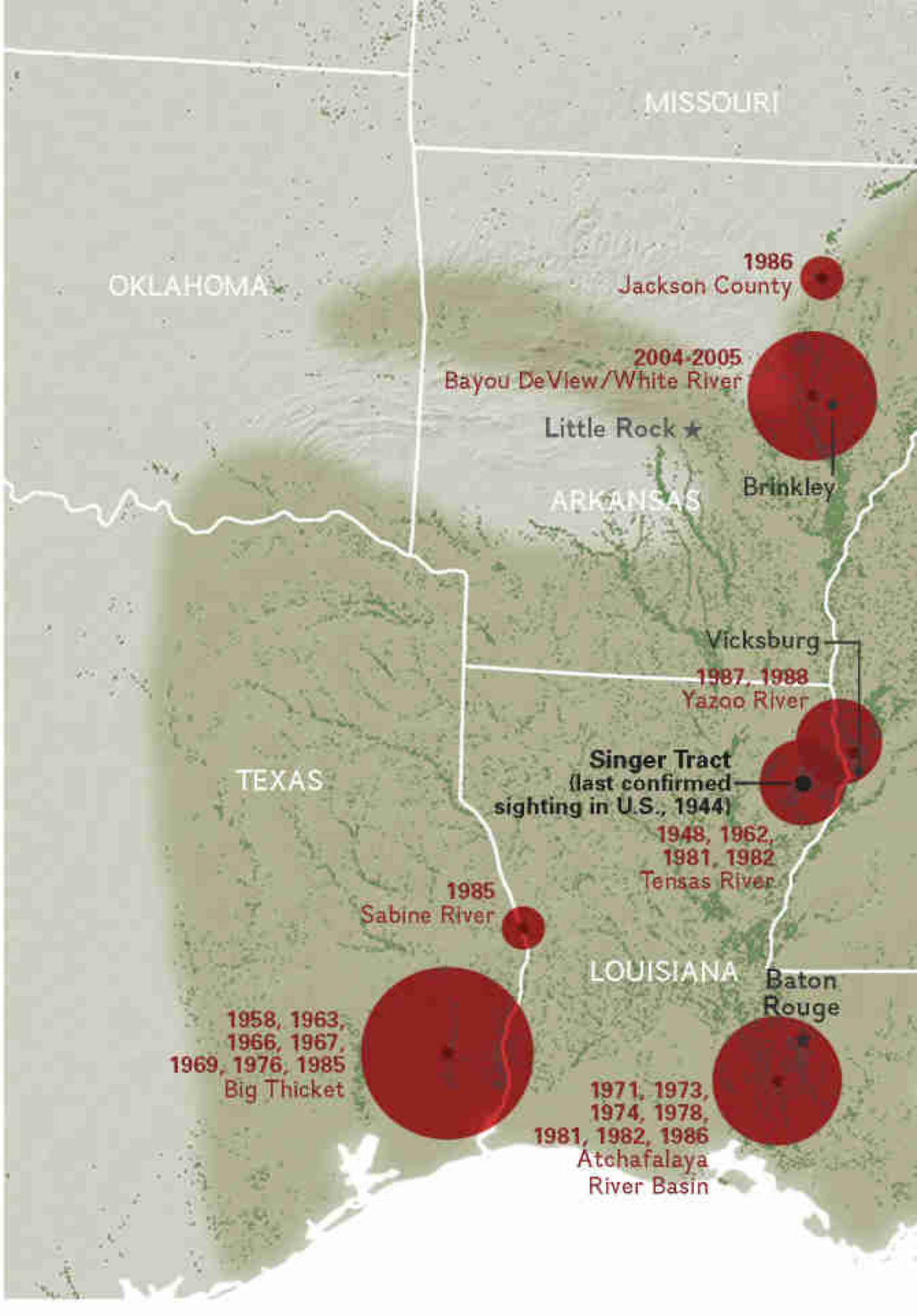
The rediscovery of this legendary bird of the great southern forests, which most ornithologists and bird-watchers thought had probably been extinct since the 1940s, made news around the world. Fitzpatrick called it "the conservation story of the century." Nature lovers were ecstatic; people cried when they heard the news. It seemed the closest thing to a scientific miracle anyone could imagine. The cadre of ivorybill enthusiasts who had believed in the bird for decades, and who had faced only slightly less ridicule than Bigfoot fanatics, had been vindicated.

Nearly everyone accepted the news without question. The United States government gave its

blessing through the cooperation of the Fish and Wildlife Service. The Nature Conservancy was a partner in the announcement. The journal *Science* published the search team's paper. After all, the Cornell Lab of Ornithology arguably holds first place among the world's most prestigious centers of bird study. When the Vatican issues an edict, to whom, exactly, do you appeal for a second opinion?

Almost no one in the general public knew how scant the evidence for the ivorybill's existence really was, or how recently the team itself had finally gained enough confidence and unanimity to claim scientific proof. "With all that euphoria, it was kind of a strange situation to be in," said Martjan Lammertink, the Dutch woodpecker expert who is the Cornell team's project scientist. "The whole world was superexcited about it, while we were really at the end of a pretty ambiguous field season." In fact, in the preceding ten months there had been only one sighting that the group judged valid.

The team had chosen to assert that it had proof that a single ivorybill was present in Arkansas in 2004 and early 2005. It was an act of possibly admirable courage—though, depending on what happens over the next few years, the team's judgment may well be debated for as long as anyone cares about birds. As more and more bird-watchers and ornithologists examined the evidence—seven fleeting glimpses and four seconds of fuzzy video that make the notorious Bigfoot film look like *March of the Penguins*—a controversy began that soon escalated beyond polite discussion into decidedly unscientific name-calling. The bird world split into Believers and Skeptics, and splintered further into True Believers, Agnostics, and Atheists, with former friends and colleagues at each others' throats.



FIRST REPORT in the recent flurry came in February 2004 near this bridge on Bayou DeView, in an Arkansas wildlife area. Since then 18,000 new acres have been protected.

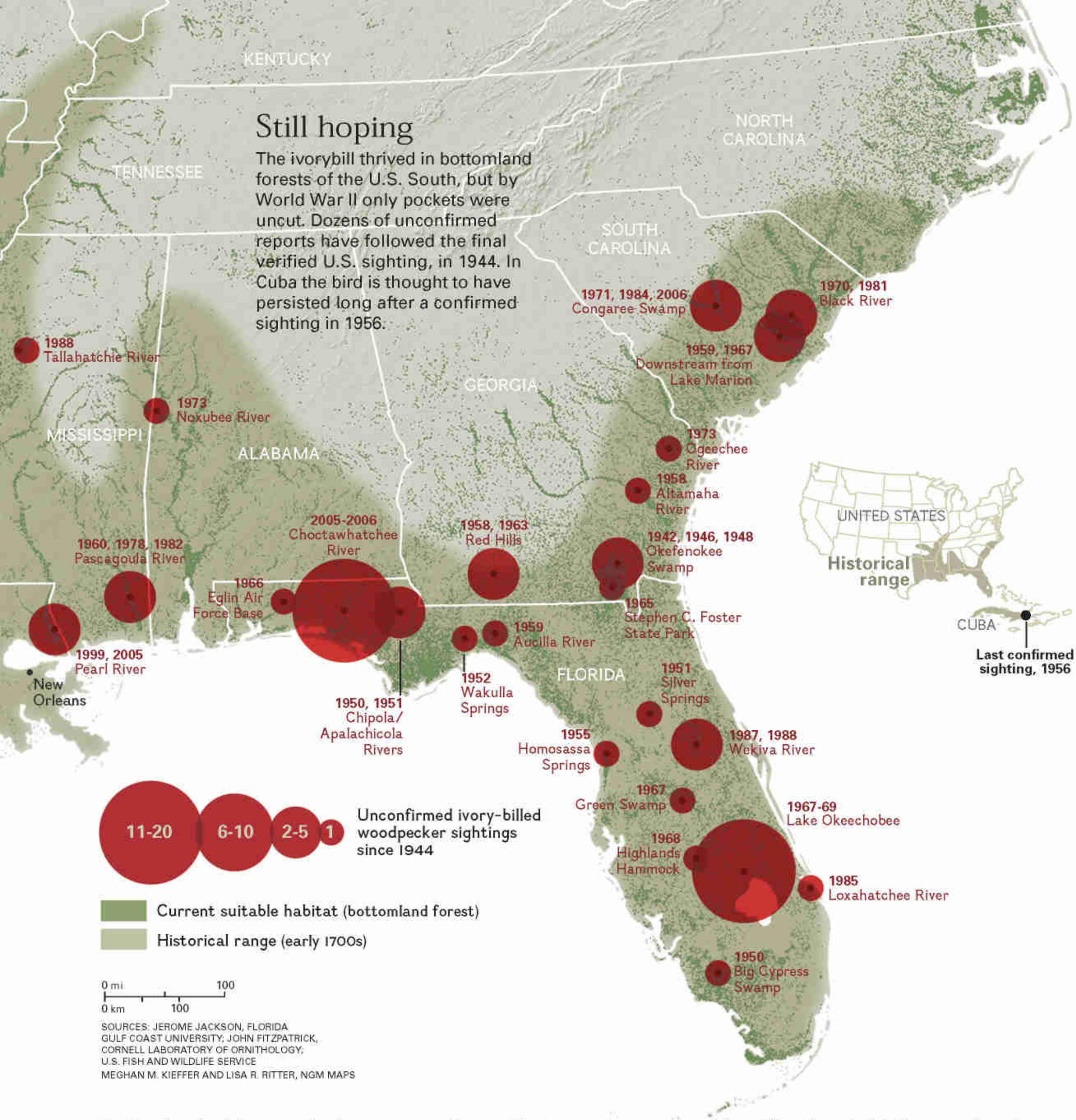
THREE WEEKS BEFORE the momentous announcement, members of the Cornell team had gathered at the Arkansas Nature Conservancy office in Little Rock to lay out their case. They discussed the seven sightings and showed the video. As good scientists, they listed the positives and negatives of their proof in great and meticulous detail.

After listening to the presentation, White River refuge manager Larry Mallard looked at Martjan Lammertink. "Martjan," he said, "we have a saying around here that you can't be just a little bit pregnant. So tell me: Are we pregnant, or are we not?"

"We're pregnant," Lammertink said.

The question of whether Lammertink had morning sickness or just a case of nerves seemed mysterious enough to most people. What was the big fuss? Was there a bird or wasn't there?

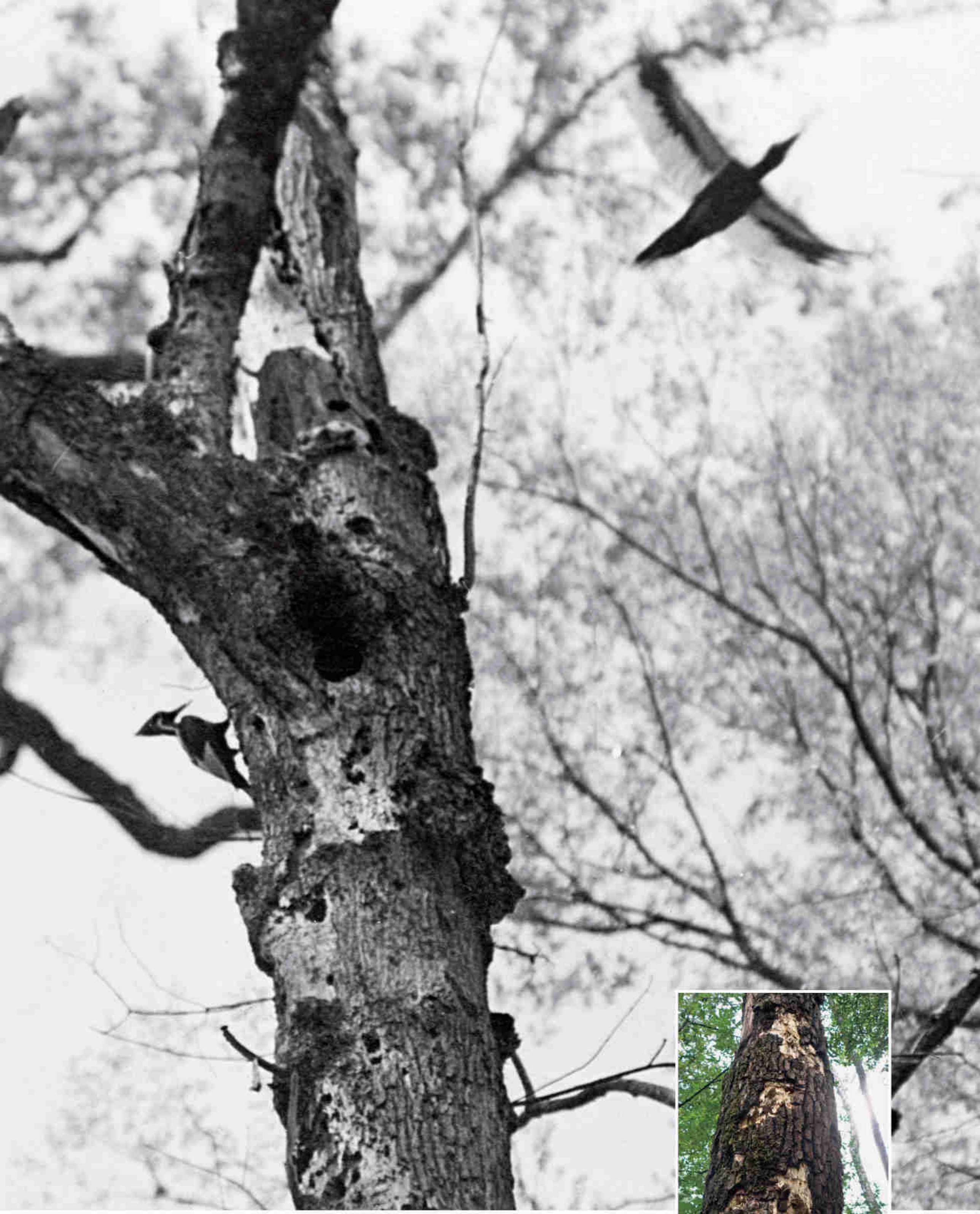
The current controversy can't be understood, nor can proof of the ivorybill's existence be



judged—lacking, as it does, a specimen that could be brought back from Arkansas like King Kong from Skull Island—without getting to know the pileated woodpecker, the joker in this game. The big, black-and-white, relatively common bird gives a raucous call that might as well be mocking the thousands of people who have mistaken it for its larger but similar relative. (Since the discovery announcement, the CLO has received nearly 3,000 reports of ivorybills, some from places as unlikely as Vancouver and Vermont.) To the Skeptics, the video and all the sightings can be dismissed as misidentifications of pileateds resulting from eager wishfulness.

David Sibley, a best-selling bird-guide author and expert on identification, initially was elated at the ivorybill news. It was, as he says, "a story that everyone wanted to believe." Soon, though, Sibley took a fresh look at the evidence and realized how little there was. Within weeks of the announcement, he was among a growing group of experts sharing their doubts in private, each having experienced a moment when, as Sibley remembers, "it struck me that that blurry video could be a pileated."

"I realized at the same time," Sibley says, "what that could mean for the credibility of conservation science. This was the biggest ornithology story of the century. It was international front-page news. What if it was wrong?"



Ivorybills nested in 1935 in Louisiana's Singer Tract. New evidence, including bark scaling (inset), suggests ivorybills may persist along the Choctawhatchee River in Florida. But without a verifiable photograph of the bird, such evidence is inconclusive.

ARTHUR A. ALLEN, COURTESY CORNELL LABORATORY OF ORNITHOLOGY; BRIAN W. ROLEK, AUBURN UNIVERSITY (INSET)

Eleven months after *Science* published the Cornell team's paper, the journal published another, with David Sibley as its lead author, asserting that the video did not rule out the possibility that the bird shown was a pileated woodpecker. Cornell simultaneously published a rebuttal. Casual bird-watchers and the general public were left confused by all the discussion of ventral surfaces, remiges, and video artifacts, but some Believers undoubtedly converted to Agnosticism, and many Agnostics became Atheists.

The ivorybill team still backs the validity of the seven sightings (and points to others that almost made the list), but its defense isn't always expressed in the strongest terms. Cornell's Ken Rosenberg, a top-level birder as well as a member of the ivorybill recovery team, stands behind the team's video analysis, but acknowledges that the video's poor quality may rule out any definitive answer. ("Do I wish we had a better video?" CLO director John Fitzpatrick asks, and immediately answers, "More than any other living human.") Of the sightings, Rosenberg says: "Even in the very best, the field notes are not what I would write, and the recollections are not . . . they're just not all there. Hopefully that doesn't come across as doubting what they saw, but it's frustrating."

Over and over, members of the team stressed how much they were influenced by the reactions of people who said they'd seen ivorybills. Fitzpatrick believed CLO staffer Tim Gallagher's sighting of February 2004 in part because of Gallagher's distraught emotional state, which to Fitzpatrick seemed "dead shock." Rosenberg, "with tears rolling down," heard and believed accounts of several of the early sightings. When Ron Rohrbaugh arrived by canoe to pick up Melanie Driscoll after her April 11, 2004, sighting, he could tell from a hundred yards away that something had happened. He thought she might have been bitten by a cottonmouth. "I remember trying to paddle faster so I could get to her. And when I got there, I got this geyser of excitement."

But in the world of science, shock and tears are not proof. Everyone, from John Fitzpatrick to the odd collection of Internet-linked eccentrics who report ivorybills practically every week in Louisiana, Florida, and points in between, has to deal with one inescapable question: Why, for all the reported sightings in the 62 years since the last undisputed ivorybill was seen, has there not been a single instance when other observers were able to return to the location, find the bird, and get a clear, unequivocally diagnostic photo?

The ivorybill's specialized feeding habits, the Believers say, force it into a nomadic existence, ranging over vast distances to find the few widely scattered dead trees that host its prey of wood-boring insects and grubs. But the notion of nomadism is a double-edged sword. If the birds constantly wander, as David Sibley says, "you would expect that sometime in the past 60 years one would show up at the boat ramp in Vicksburg, Mississippi, and spend three days on some big dead ash tree peeling bark off of it, and everybody would get to see it."

The extreme pressures of hunting and museum-collecting on a tiny remnant population in the 19th and early 20th centuries, some Believers say, eliminated the noisy, unwary birds. Natural selection favored the survival traits of silence and extreme shyness, leaving a few nearly mute and hyper-timid individuals far different from the species said to be revered by Native Americans for its courage. (Many scientists, however, doubt that such behavioral change could occur in only two centuries or so.)

Whereupon the Skeptics point to the real elephant in the room: At least occasionally, ivorybill pairs must court, mate, excavate a cavity, lay eggs, incubate eggs, and feed the young in the nest, all of which requires the birds to remain in the same location for well over two months. Why, in 62 years, has not a single nest been found? This, perhaps more than anything else, is a problem for teetering Skeptics who might otherwise lean toward belief.

But then Rosenberg, Rohrbaugh, and Lammertink—along with Believers everywhere—go on to express an idea that could possibly be true, and indeed must be true if there are ivorybills on this Earth: There are great areas of southern bottomland forest where few people go, where a few pairs of birds could nest, perhaps not even every year but every few years, and not be found. "Can I imagine that a small, thinly distributed population, just enough to stay alive, has persisted to the present?" John Fitzpatrick asks. "I can imagine it."

OFF AND ON for two years, I walked the White River bottomland forests with ivorybill searchers,

Collected by scientists between 1869 and 1914, the world's largest archive, more than 60 specimens,

resides at Harvard University. The birds were doomed in large part by unchecked logging.

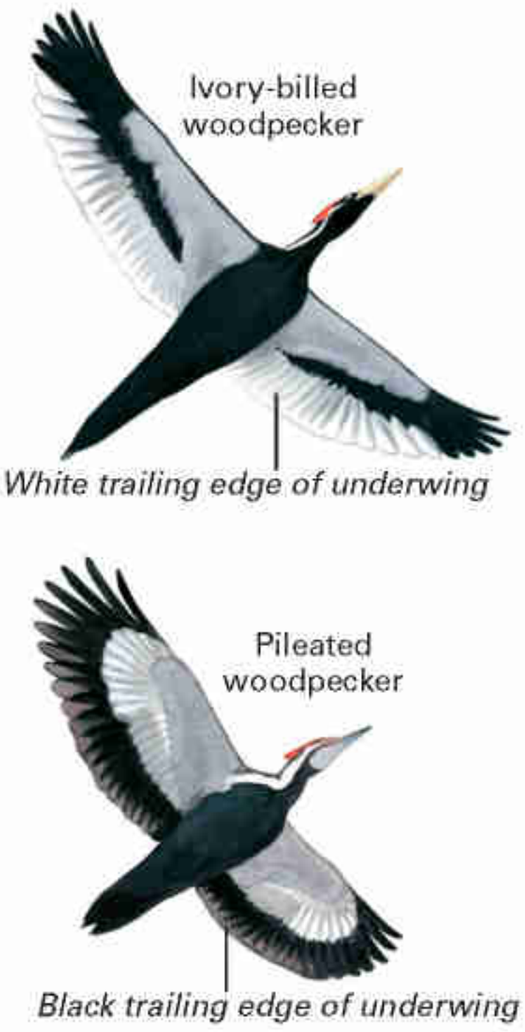
bunked with them in a duck lodge, ate catfish and drank beer with them, and questioned them about everything from childhood dreams to, reluctantly but inevitably, scientific credibility. In the spirit of disclosure, I admit that I came to like and respect nearly all of them. It occurred to me that if I were going to be skeptical, then I owed it to them and to the ivorybill (or its memory) to look into the eyes of someone not currently on the team who had seen the bird and hear the story firsthand. And so I did.

Melanie Driscoll's eyes, in Ken Rosenberg's opinion, were witness to "the best sighting of all" of the seven cited by the ivorybill team. As she sat across the table at a Baton Rouge coffee shop, she was neither seeking my approval nor apprehensive about my reaction, but instead simply relating her experience—and I could take it or leave it. She has in the past been introduced to people who, upon hearing that she's one of those who saw the ivorybill, rolled their eyes and stalked away without a word. And she has met True Believers who immediately and unquestioningly idolized her like a rock star, even though it was obvious that they hadn't studied the evidence or learned much of anything about the whole situation. Those people, she said, irritate her as much as the Skeptics.

After she saw the ivorybill, she said, her first thought was, "For the love of God, I can't cry. I'm a scientist."

She told me how she got her ten-power binoculars on the flying bird and "managed to get about three complete wingbeats where I could distinguish up- and downstroke. On each stroke I could see white to the trailing edge, both on the underside of the wing and the upperside of the wing," as well as "white on the neck moving all the way down the neck and across the body to almost meet with the white in the wings." All of which, if you have even a mustard seed's worth of faith, makes you jump for joy that the ivorybill lives, and if you are a Skeptic, causes you to search for reasons why this woman did not see an ivory-billed woodpecker.

WOODPECKER WINGS



Many of America's top birdwatchers, including David Sibley, have a simple answer: Birders, even the best birders, make mistakes. Every instance of field identification is a judgment call, a sorting of information and formation of an opinion, and sometimes the conclusion is wrong. "It has nothing to do with honesty or expertise or truthfulness," Sibley says. "We all make these kinds of mistakes. We get excited about a possibility, and our brain tends to jump to that possibility whenever we see something remotely similar."

Melanie Driscoll told me, as calmly as if she were asking for more hot water for her tea: "I am one hundred percent certain I saw an ivorybill." She laughed when she remembered how, even at the time of her sighting, she knew people would think she was crazy. "At least if I was going to be thrown in a loony bin, I'd have good company," she said. "So, yeah, I don't expect people to believe my sighting. It's unfortunate, but true. I find it incredible that anybody believes the sightings, in some ways. We do expect more objective evidence now."

THE BILLBOARDS are still up along Interstate 40, inviting drivers to stop at Brinkley, the Home of the Ivory-billed Woodpecker. The town began as a railroad camp called Lick Skillet, and trains stayed busy in the late 19th century hauling giant trees from the seemingly endless forests of what was then known as the great swamp of Arkansas. The loggers were so efficient that when they were through, there was hardly any woodland left except along streams—like Bayou DeView—and the last ivorybill disappeared from these parts well before soldiers boarded the trains to fight in World War I. Unless, well, you know. . . .

Until April 28, 2005, Brinkley was dying along with so many small eastern Arkansas towns. Its dreams were answered by the rediscovery of the ivorybill, the iconic symbol of vanished wilderness, just three miles from the local McDonald's. People started and renamed businesses; hunting guides became bird guides;

ART BY DAVID ALLEN SIBLEY

DOUBLE TAKE: Recently reported ivorybill sightings, many experts say, may be cases of mistaken identity. The pileated woodpecker (above) is only slightly smaller than the ivorybill, and the differences between them are subtle to all but an expert. The black-and-white patterns on their wings give them away (opposite), but are difficult to spot.

sporting lodges pitched their advertising to birders; tourists came and spent money; the town's first Call of the Ivory-billed Woodpecker Celebration attracted 250 people from around the country to the convention center.

I talked to Katie and Thomas Jacques, co-publishers of the Brinkley newspaper, in their office behind the post office. They had just printed a review of the eventful year following the ivorybill announcement. So much had happened, in fact, that the story spread over two editions of the *Brinkley Argus.*

I asked if the town had considered what would happen if the ivorybill was never seen again. Katie laughed and said, "That question was being asked long before now."

Brinkley has an answer, all right—in a New Mexico town that's done quite well for itself as a pilgrimage site for a slightly different kind of Believer.

"Look at Roswell," Katie Jacques said. "That whole UFO crash deal was based on a little newspaper article in, what, 1946, '47? So it doesn't take much to still get people to come to an area if there's even a faint glimmer of hope of something that's wonderful."

The Cornell team hasn't given up on finding an ivorybill in Arkansas and, in fact, will return to the Big Woods for the winter-spring search season of 2006-2007, albeit with greatly reduced support. And despite the lack of success in Arkansas, the U.S. Fish and Wildlife Service has decided to fund searches in possibly suitable habitat in several other southern states, with the

goal of determining once and for all whether the ivorybill lives. Cornell plans to send out a traveling SWAT team to advise local searchers in places such as Florida's Choctawhatchee River Basin, site of a flurry of recent unconfirmed sightings.

As Ron Rohrbaugh says, Cornell has developed some "pretty sophisticated" technology to search for ivorybills. That technology, though, works for both positive and negative results. Remote camera techniques painstakingly created by the search team have shown that the kind of bark scaling once thought to be the work of ivorybills is also commonly done by pileateds. High-tech audio analysis has shown how many species of common birds—especially blue jays, white-breasted nuthatches, and red-winged blackbirds—make sounds that can fool a listener into thinking that an ivorybill was the source. (Understandably, some believers ask how blue jays, noted mimics, could imitate a bird that had been extinct for decades.) Either way, Cornell's improved techniques could end up, during upcoming region-wide searching, primarily gathering evidence that the ivory-billed woodpecker is indeed extinct.

As more and more experts examined the evidence—seven fleeting glimpses and four seconds of fuzzy video that make the notorious Bigfoot film look like *March of the Penguins*—the controversy escalated.

There's more at stake here than the existence or absence of a single species. University of Kansas ornithologist Mark Robbins, one of Cornell's most acerbic critics, says he got involved in the controversy primarily "because I'm so disgusted that we're taking money from species that aren't extinct, that are in trouble" elsewhere in the federal endangered species program.

A serious push has been under way in Congress for some time to revise the Endangered Species Act (eviscerate it, conservationists say), and some worry that the ivorybill episode could give ammunition to politicians and pundits who might claim that environmentalists overreact, abuse and manipulate science, and use scare tactics to achieve their goals.

David Sibley isn't completely gloomy, though. He says that as long as the situation "doesn't blow up into some conspiracy theory or scandal that's going to damage conservation, I think that in the long run some good will come out of it. I have a lot of faith in people and our ability to move on from things like this. I think that the attention that has been focused on the Big Woods and the habitat is good."

That attention is what Cornell's John Fitzpatrick was talking about when he said, "This is a conservation story and a science story, not a bird-watching story." Skeptics charge that Fitzpatrick is guilty of "mission creep," changing the focus of the project to distract from the possibility that the ivorybill doesn't exist. It might be partly true—but I will testify that he's been saying the same thing from the day I met him back in March 2004. In that time of excitement and confidence, he repeatedly used the analogy that "the media totally missed the story on the spotted owl." The issue wasn't "the poor little brown-eyed bird," he said, but the ongoing destruction of the old-growth forests of the Pacific Northwest. The issue with the ivorybill, he said, is expanding the protected areas in the Big Woods of Arkansas.

"Is it possible," Fitzpatrick asks, "that we could bring back in the United States of America one big piece of land that looks like it did when Audubon was here? The answer is yes. There's the place to do it. And whether or not the ivorybill ends up persisting out there is totally irrelevant. What the ivorybill tells us is not irrelevant. It tells us that we have opportunities that we can take, or we can not take. We should take them."

Many would agree that conserving the Big Woods is an admirable goal. It might be argued, though, that the existence of the ivorybill is hardly irrelevant to the people who cried when they heard of its rediscovery, or to the people linked to the story. Melanie Driscoll was recruited for a secret assignment and watched a bird fly across a forest opening for about four seconds. She believes in the sightings that were the basis of the rediscovery announcement, but she's also realistic enough to give voice to the possibility that, if the ivorybill isn't seen again, history will say that "this was mass hysteria, that nobody saw what they thought they saw, that the ivorybill did go extinct 60 years ago, or 25 years ago, and we just didn't know it at the time."

"I'M A BELIEVER. I think we'll find it," says James R. Hill III, at left, who was in charge of Cornell's remote surveillance cameras. He and biologist Waylon Edwards ate on their feet this past season in Arkansas's White River National Wildlife Refuge. The search continues.

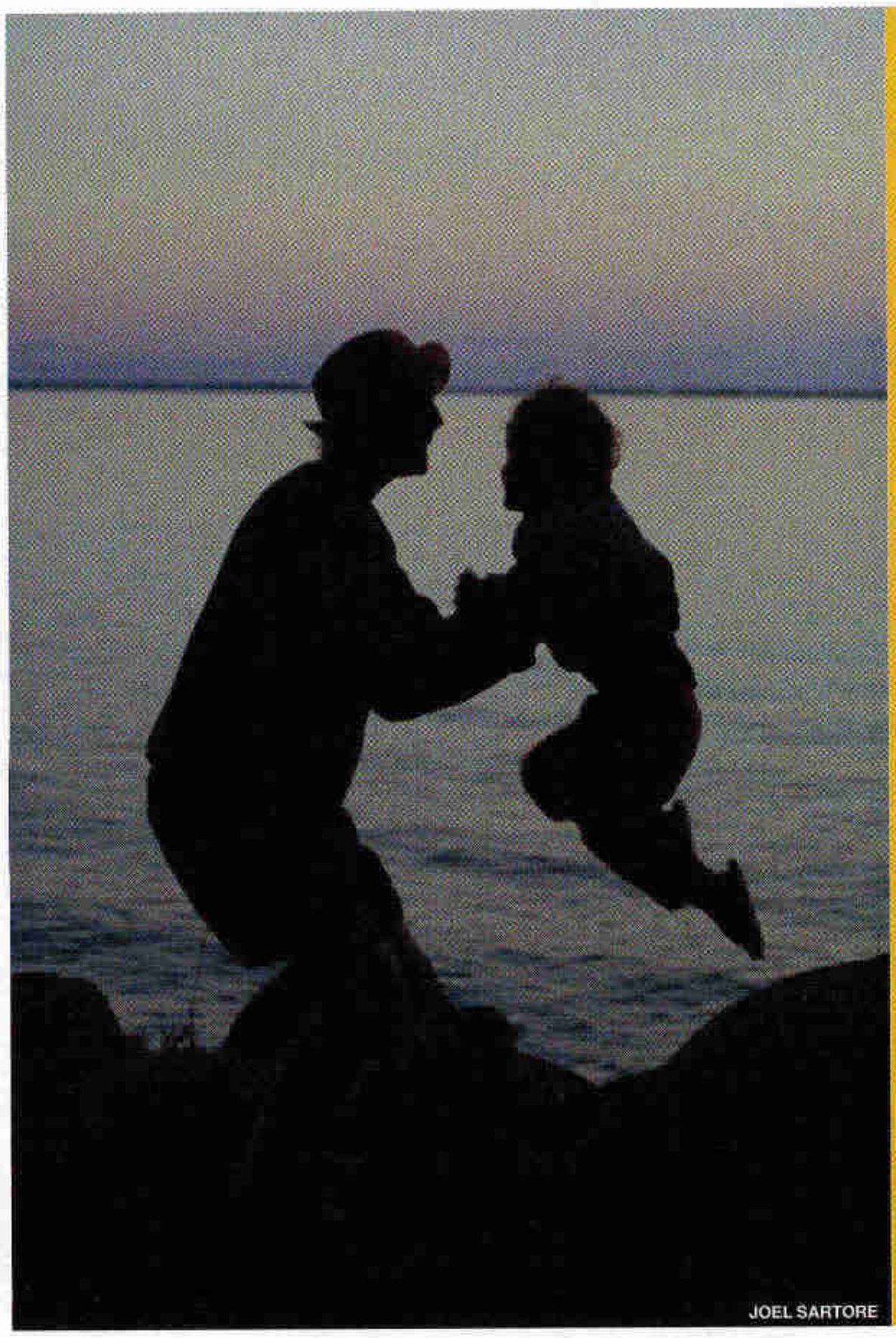
If another search season passes with no indisputable proof, it's inevitable that more people will come to believe that the Arkansas ivorybill was just another in a long series of false alarms and cases of mistaken identity. You don't have to be a mathematician to make up your own odds that the Bayou DeView ivorybill happened to be the last living individual of its species. Arguments will continue for years, though, because no one will ever be able to prove that there was *not* an ivory-billed woodpecker in Arkansas in 2004 and 2005.

For its part, the Cornell team points out that it never claimed anything other than that there was a single individual present on seven particular days during a span of 14 months. Since then, as more than one Cornell staffer said to me, "the bird could have been hit by a truck on Interstate 40."

IN THE BIG WOODS, another spring will bring new leaves to the towering Nuttall oaks and sweet gums and centuries-old bald cypresses. Black bears will emerge from their dens in massive hollow sycamores, and bald eagle chicks will beg for food from their parents. Swallow-tailed kites and Swainson's warblers will build nests, cottonmouths will uncoil and set off in search of unwary bullfrogs, and wood ducks will lead their young across bayous that are home to alligator gar as long as kayaks.

Searchers will keep coming, too, not just to Arkansas but to South Carolina's Congaree Swamp and Louisiana's Atchafalaya River Basin and the other great forests of the South. They'll be there with their binoculars and cameras, listening, scanning the sky, their hearts jumping every time a pileated woodpecker flashes through the trees. Many will be Believers, but not all, because no bird in history has meant so much to so many people as the ivorybill—and no one, not even the Skeptics, wants to give up on the Maybe that means one last hope for the ghost bird. □

Ivorybill Stories Listen to the tales of birder Bobby Harrison. Nancy Tanner talks about her 1944 sighting, the last one confirmed, at **ngm.com/0612.**



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Toyota Motor Corporation is delighted to host the 2006 FIFA Club World Cup in Japan December 10-17. This prestigious tournament, which originated as the Toyota European/South American Cup in 1981, brings together championship soccer clubs from six continents to decide the club champions of the world. This year's contenders include UEFA champions FC Barcelona and CONMEBOL winners SC Internacional from Brazil alongside clubs from the AFC (Asia), CAF (Africa), CONCACAF (North America, Central America, and the Caribbean), and OFC (Oceania).

JAPAN 2006 FIFA CLUB WORLD CUP TOYOTA

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HOW TO HELP

Sentinels of Freedom, a California group, helped Joey Bozik (here with wife, Jayme) secure housing and a job after he was injured in Iraq.

When They Come Home For many injured service members returning from war—and for their families—a new battle has begun. Issues of physical recovery, post-military training and employment, and the stresses of everyday life present huge challenges. Hundreds of nonprofit and other organizations, many run on shoestring budgets, have sprung up to help veterans navigate their futures. These are just a few:

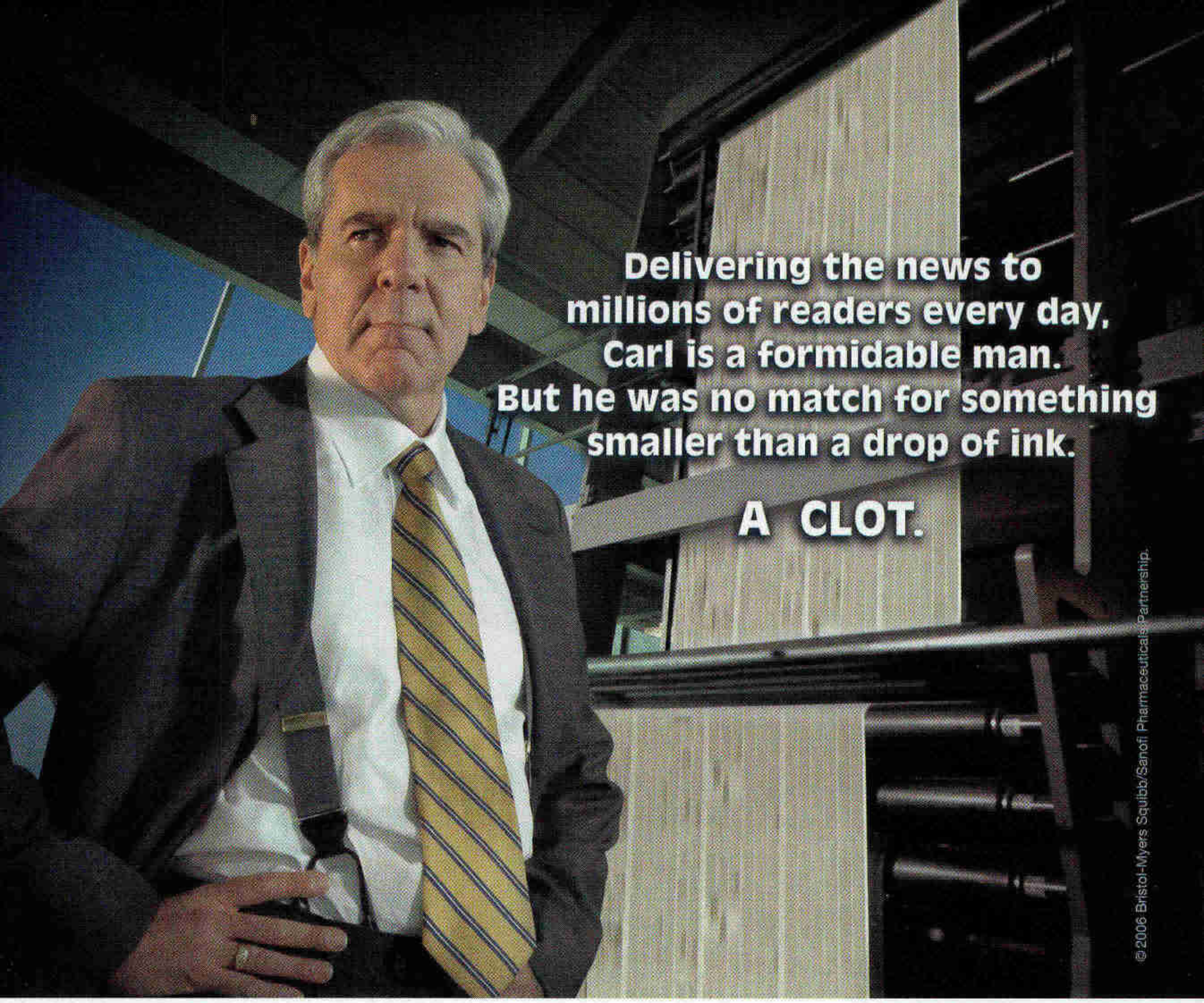
- **Fisher House Foundation** has provided lodging for more than 100,000 service members and their families at major U.S. military and VA medical centers since 1991. Now 35 of their custom-built homes accommodate families free of charge. *fisherhouse.org*

- **Operation Comfort** helps families of patients at Brooke Army Medical Center in Texas by funding travel and other services. The group also offers fun activities—from dinners out to ski trips—for otherwise hospital-bound vets. *operationcomfort.org*

- **Wounded Warrior Project** works to smooth the transition of severely injured service members and vets back to civilian life, offering personal counseling, financial and job advice, advocacy, and sports and recreational programs for them and their families. *woundedwarriorproject.org*

- **Yellow Ribbon Fund** arranges temporary housing, transportation, and more for families and patients at Walter Reed Army Medical Center in Washington, D.C., and the National Naval Medical Center in Bethesda, Maryland. *yellowribbonfund.com*

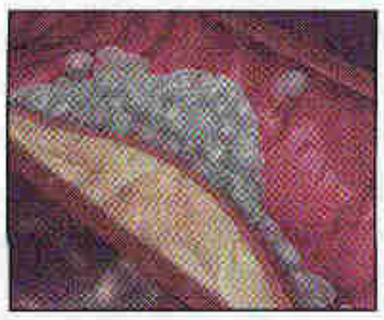
PHOTO: JAMES NACHTWEY



Clots are the number one cause of heart attack and stroke, but you can help reduce your risk.

This is important information if you've been hospitalized with heart-related chest pain or a certain type of heart attack.

That's because these conditions, known as Acute Coronary Syndrome–or ACS –are usually caused when blood platelets stick together and form clots that block blood flow to your heart. And if you've already had a clot, you're at an increased risk for a future heart attack or stroke.



PLAVIX, in combination with aspirin, helps provide greater protection against a future heart attack or stroke than aspirin alone.

PLAVIX, taken with aspirin, plays its own role in helping reduce your risk of heart attack and stroke. That's because, unlike your cholesterol and blood pressure medications, prescription PLAVIX works to help keep blood platelets from sticking together and forming clots.

IMPORTANT INFORMATION: If you have a stomach ulcer or other condition that causes bleeding, you shouldn't use PLAVIX. When taking PLAVIX alone or with some medicines including aspirin, the risk of bleeding may increase. To minimize this risk, talk to your doctor before taking aspirin or other medicines with PLAVIX. Additional rare but serious side effects could occur.

Talk to your doctor today to learn more about PLAVIX.
Or visit www.plavix.com or call 1.800.866.0239.

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INDICATIONS AND USAGE

PLAVIX (clopidogrel bisulfate) is indicated for the reduction of atherothrombotic events as follows:

- **Recent MI, Recent Stroke or Established Peripheral Arterial Disease**
  For patients with a history of recent myocardial infarction (MI), recent stroke, or established peripheral arterial disease, PLAVIX has been shown to reduce the rate of a combined endpoint of new ischemic stroke (fatal or not), new MI (fatal or not), and other vascular death.
- **Acute Coronary Syndrome**
  For patients with acute coronary syndrome (unstable angina/non-Q-wave MI) including patients who are to be managed medically and those who are to be managed with percutaneous coronary intervention (with or without stent) or CABG, PLAVIX has been shown to decrease the rate of a combined endpoint of cardiovascular death, MI, or stroke as well as the rate of a combined endpoint of cardiovascular death, MI, stroke, or refractory ischemia.

CONTRAINDICATIONS

The use of PLAVIX is contraindicated in the following conditions:

- Hypersensitivity to the drug substance or any component of the product.
- Active pathological bleeding such as peptic ulcer or intracranial hemorrhage.

WARNINGS

Thrombotic thrombocytopenic purpura (TTP):

TTP has been reported rarely following use of PLAVIX, sometimes after a short exposure (<2 weeks). TTP is a serious condition that can be fatal and requires urgent treatment including plasmapheresis (plasma exchange). It is characterized by thrombocytopenia, microangiopathic hemolytic anemia (schistocytes [fragmented RBCs] seen on peripheral smear), neurological findings, renal dysfunction, and fever. (See **ADVERSE REACTIONS**.)

PRECAUTIONS

General

PLAVIX prolongs the bleeding time and therefore should be used with caution in patients who may be at risk of increased bleeding from trauma, surgery, or other pathological conditions (particularly gastrointestinal and intraocular). If a patient is to undergo elective surgery and an antiplatelet effect is not desired, PLAVIX should be discontinued 5 days prior to surgery.

Due to the risk of bleeding and undesirable hematological effects, blood cell count determination and/or other appropriate testing should be promptly considered, whenever such suspected clinical symptoms arise during the course of treatment (see **ADVERSE REACTIONS**).

In patients with recent TIA or stroke who are at high risk for recurrent ischemic events, the combination of aspirin and PLAVIX has not been shown to be more effective than PLAVIX alone, but the combination has been shown to increase major bleeding.

GI Bleeding: In CAPRIE, PLAVIX was associated with a rate of gastrointestinal bleeding of 2.0%, vs. 2.7% on aspirin. In CURE, the incidence of major gastrointestinal bleeding was 1.3% vs 0.7% (PLAVIX + aspirin vs. placebo + aspirin, respectively). PLAVIX should be used with caution in patients who have lesions with a propensity to bleed (such as ulcers). Drugs that might induce such lesions should be used with caution in patients taking PLAVIX.

Use in Hepatically Impaired Patients: Experience is limited in patients with severe hepatic disease, who may have bleeding diatheses. PLAVIX should be used with caution in this population.

Use in Renally-impaired Patients: Experience is limited in patients with severe renal impairment. PLAVIX should be used with caution in this population.

Information for Patients

Patients should be told it may take them longer than usual to stop bleeding, that they may bruise and/or bleed more easily when they take PLAVIX or PLAVIX combined with aspirin, and that they should report any unusual bleeding to their physician. Patients should inform physicians and dentists that they are taking PLAVIX and/or any other product known to affect bleeding before any surgery is scheduled and before any new drug is taken.

Drug Interactions

Study of specific drug interactions yielded the following results:

Aspirin: Aspirin did not modify the clopidogrel-mediated inhibition of ADP-induced platelet aggregation. Concomitant administration of 500 mg of aspirin twice a day for 1 day did not significantly increase the prolongation of bleeding time induced by PLAVIX. PLAVIX potentiated the effect of aspirin on collagen-induced platelet aggregation. PLAVIX and aspirin have been administered together for up to one year.

Heparin: In a study in healthy volunteers, PLAVIX did not necessitate modification of the heparin dose or alter the effect of heparin on coagulation. Coadministration of heparin had no effect on inhibition of platelet aggregation induced by PLAVIX.

Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): In healthy volunteers receiving naproxen, concomitant administration of PLAVIX was associated with increased occult gastrointestinal blood loss. NSAIDs and PLAVIX should be coadministered with caution.

Warfarin: Because of the increased risk of bleeding, the concomitant administration of warfarin with PLAVIX should be undertaken with caution. (See **PRECAUTIONS– General.**)

Other Concomitant Therapy: No clinically significant pharmacodynamic interactions were observed when PLAVIX was coadministered with **atenolol, nifedipine,** or both atenolol and nifedipine. The pharmacodynamic activity of PLAVIX was also not significantly influenced by the coadministration of **phenobarbital, cimetidine** or **estrogen.**

The pharmacokinetics of **digoxin** or **theophylline** were not modified by the coadministration of PLAVIX (clopidogrel bisulfate).

At high concentrations *in vitro,* clopidogrel inhibits P_{450} (2C9). Accordingly, PLAVIX may interfere with the metabolism of **phenytoin, tamoxifen, tolbutamide, warfarin, torsemide, fluvastatin,** and many **non-steroidal anti-inflammatory agents,** but there are no data with which to predict the magnitude of these interactions. Caution should be used when any of these drugs is coadministered with PLAVIX.

In addition to the above specific interaction studies, patients entered into clinical trials with PLAVIX received a variety of concomitant medications including **diuretics, beta-blocking agents, angiotensin converting enzyme inhibitors, calcium antagonists, cholesterol lowering agents, coronary vasodilators, antidiabetic agents** (including **insulin), antiepileptic agents, hormone replacement therapy, heparins** (unfractionated and LMWH) and **GPIIb/IIIa antagonists** without evidence of clinically significant adverse interactions. The use of oral anticoagulants, non-study anti-platelet drug and chronic NSAIDs was not allowed in CURE and there are no data on their concomitant use with clopidogrel.

Drug/Laboratory Test Interactions

None known.

Carcinogenesis, Mutagenesis, Impairment of Fertility

There was no evidence of tumorigenicity when clopidogrel was administered for 78 weeks to mice and 104 weeks to rats at dosages up to 77 mg/kg per day, which afforded plasma exposures >25 times that in humans at the recommended daily dose of 75 mg.

Clopidogrel was not genotoxic in four *in vitro* tests (Ames test, DNA-repair test in rat hepatocytes, gene mutation assay in Chinese hamster fibroblasts, and metaphase chromosome analysis of human lymphocytes) and in one *in vivo* test (micronucleus test by oral route in mice).

Clopidogrel was found to have no effect on fertility of male and female rats at oral doses up to 400 mg/kg per day (52 times the recommended human dose on a mg/m^2 basis).

Pregnancy

Pregnancy Category B. Reproduction studies performed in rats and rabbits at doses up to 500 and 300 mg/kg/day (respectively, 65 and 78 times the recommended daily human dose on a mg/m^2 basis), revealed no evidence of impaired fertility or fetotoxicity due to clopidogrel. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of a human response, PLAVIX should be used during pregnancy only if clearly needed.

Nursing Mothers

Studies in rats have shown that clopidogrel and/or its metabolites are excreted in the milk. It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk and because of the potential for serious adverse reactions in nursing infants, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the nursing woman.

Pediatric Use

Safety and effectiveness in the pediatric population have not been established.

Geriatric Use

Of the total number of subjects in controlled clinical studies, approximately 50% of patients treated with PLAVIX were 65 years of age and over. Approximately 16% of patients treated with PLAVIX were 75 years of age and over.

The observed difference in risk of thrombotic events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Figure 3 (see **CLINICAL STUDIES**). The observed difference in risk of bleeding events with clopidogrel plus aspirin versus placebo plus aspirin by age category is provided in Table 3 (see **ADVERSE REACTIONS**).

ADVERSE REACTIONS

PLAVIX has been evaluated for safety in more than 17,500 patients, including over 9,000 patients treated for 1 year or more. The overall tolerability of PLAVIX in CAPRIE was similar to that of aspirin regardless of age, gender and race, with an approximately equal incidence (13%) of patients withdrawing from treatment because of adverse reactions. The clinically important adverse events observed in CAPRIE and CURE are discussed below.

Hemorrhagic: In CAPRIE patients receiving PLAVIX, gastrointestinal hemorrhage occurred at a rate of 2.0%, and required hospitalization in 0.7%. In patients receiving aspirin, the corresponding rates were 2.7% and 1.1%, respectively. The incidence of intracranial hemorrhage was 0.4% for PLAVIX compared to 0.5% for aspirin.

In CURE, PLAVIX use with aspirin was associated with an increase in bleeding compared to placebo with aspirin (see Table 3). There was an excess in major bleeding in patients receiving PLAVIX plus aspirin compared with placebo plus aspirin, primarily gastrointestinal and at puncture sites. The incidence of intracranial hemorrhage (0.1%), and fatal bleeding (0.2%), were the same in both groups.

The overall incidence of bleeding is described in Table 3 for patients receiving both PLAVIX and aspirin in CURE,

Table 3: CURE Incidence of bleeding complications (% patients)

Event	PLAVIX (+ aspirin)* (n=6259)	Placebo (+ aspirin)* (n=6303)	P-value
Major bleeding †	3.7 ‡	2.7 §	0.001
Life-threatening bleeding	2.2	1.8	0.13
Fatal	0.2	0.2	
5 g/dL hemoglobin drop	0.9	0.9	
Requiring surgical intervention	0.7	0.7	
Hemorrhagic strokes	0.1	0.1	
Requiring inotropes	0.5	0.5	
Requiring transfusion (≥4 units)	1.2	1.0	
Other major bleeding	1.6	1.0	0.005
Significantly disabling	0.4	0.3	
Intraocular bleeding with significant loss of vision	0.05	0.03	
Requiring 2-3 units of blood	1.3	0.9	
Minor bleeding ¶	5.1	2.4	<0.001

* Other standard therapies were used as appropriate.

† Life threatening and other major bleeding.

‡ Major bleeding event rate for PLAVIX + aspirin was dose-dependent on aspirin: <100 mg=2.6%; 100-200 mg= 3.5%; >200 mg=4.9%
Major bleeding event rates for PLAVIX + aspirin by age were: <65 years = 2.5%, ≥65 to <75 years = 4.1%, ≥75 years 5.9%

§ Major bleeding event rate for placebo + aspirin was dose-dependent on aspirin: <100 mg=2.0%; 100-200 mg= 2.3%; >200 mg=4.0%
Major bleeding event rates for placebo + aspirin by age were: <65 years = 2.1%, ≥65 to <75 years = 3.1%, ≥75 years 3.6%

¶ Led to interruption of study medication.

Ninety-two percent (92%) of the patients in the CURE study received heparin/LMWH, and the rate of bleeding in these patients was similar to the overall results.

There was no excess in major bleeds within seven days after coronary bypass graft surgery in patients who stopped therapy more than five days prior to surgery (event rate 4.4% PLAVIX + aspirin; 5.3% placebo + aspirin). In patients who remained on therapy within five days of bypass graft surgery, the event rate was 9.6% for PLAVIX + aspirin, and 6.3% for placebo + aspirin.

Neutropenia/agranulocytosis: Ticlopidine, a drug chemically similar to PLAVIX, is associated with a 0.8% rate of severe neutropenia (less than 450 neutrophils/μL). In CAPRIE severe neutropenia was observed in six patients, four on PLAVIX and two on aspirin. Two of the 9599 patients who received PLAVIX and none of the 9586 patients who received aspirin had neutrophil counts of zero. One of the four PLAVIX patients in CAPRIE was receiving cytotoxic chemotherapy, and another recovered and returned to the trial after only temporarily interrupting treatment with PLAVIX (clopidogrel bisulfate). In CURE, the numbers of patients with thrombocytopenia (19 PLAVIX + aspirin vs. 24 placebo + aspirin) or neutropenia (3 vs. 3) were similar.

Although the risk of myelotoxicity with PLAVIX (clopidogrel bisulfate) thus appears to be quite low, this possibility should be considered when a patient receiving PLAVIX demonstrates fever or other sign of infection.

Gastrointestinal: Overall, the incidence of gastrointestinal events (e.g. abdominal pain, dyspepsia, gastritis and constipation) in patients receiving PLAVIX (clopidogrel bisulfate) was 27.1%, compared to 29.8% in those receiving aspirin in the CAPRIE trial. In the CURE trial the incidence of these gastrointestinal events for patients receiving PLAVIX + aspirin was 11.7% compared to 12.5% for those receiving placebo + aspirin.

In the CAPRIE trial, the incidence of peptic, gastric or duodenal ulcers was 0.7% for PLAVIX (clopidogrel bisulfate) and 1.2% for aspirin. In the CURE trial the incidence of peptic, gastric or duodenal ulcers was 0.4% for PLAVIX + aspirin and 0.3% for placebo + aspirin.

Cases of diarrhea were reported in the CAPRIE trial in 4.5% of patients in the PLAVIX group compared to 3.4% in the aspirin group. However, these were rarely severe (PLAVIX=0.2% and aspirin=0.1%). In the CURE trial, the incidence of diarrhea for patients receiving PLAVIX + aspirin was 2.1% compared to 2.2% for those receiving placebo + aspirin.
In the CAPRIE trial, the incidence of patients withdrawing from treatment because of gastrointestinal adverse reactions was 3.2% for PLAVIX and 4.0% for aspirin. In the CURE trial, the incidence of patients withdrawing from treatment because of gastrointestinal adverse reactions was 0.9% for PLAVIX + aspirin compared with 0.8% for placebo + aspirin.
Rash and Other Skin Disorders: In the CAPRIE trial, the incidence of skin and appendage disorders in patients receiving PLAVIX was 15.8% (0.7% serious); the corresponding rate in aspirin patients was 13.1% (0.5% serious). In the CURE trial the incidence of rash or other skin disorders in patients receiving PLAVIX + aspirin was 4.0% compared to 3.5% for those receiving placebo + aspirin.
In the CAPRIE trial, the overall incidence of patients withdrawing from treatment because of skin and appendage disorders adverse reactions was 1.5% for PLAVIX and 0.8% for aspirin. In the CURE trial, the incidence of patients withdrawing because of skin and appendage disorders adverse reactions was 0.7% for PLAVIX + aspirin compared with 0.3% for placebo + aspirin.
Adverse events occurring in ≥2.5% of patients on PLAVIX in the CAPRIE controlled clinical trial are shown below regardless of relationship to PLAVIX. The median duration of therapy was 20 months, with a maximum of 3 years.

Table 4: Adverse Events Occurring in ≥2.5% of PLAVIX Patients in CAPRIE

Body System **Event**	**% Incidence (% Discontinuation)** **PLAVIX [n=9599]**	**Aspirin [n=9586]**
Body as a Whole – general disorders		
Chest Pain	8.3 (0.2)	8.3 (0.3)
Accidental/Inflicted Injury	7.9 (0.1)	7.3 (0.1)
Influenza-like symptoms	7.5 (<0.1)	7.0 (<0.1)
Pain	6.4 (0.1)	6.3 (0.1)
Fatigue	3.3 (0.1)	3.4 (0.1)
Cardiovascular disorders, general		
Edema	4.1 (<0.1)	4.5 (<0.1)
Hypertension	4.3 (<0.1)	5.1 (<0.1)
Central & peripheral nervous system disorders		
Headache	7.6 (0.3)	7.2 (0.2)
Dizziness	6.2 (0.2)	6.7 (0.3)
Gastrointestinal system disorders		
Abdominal pain	5.6 (0.7)	7.1 (1.0)
Dyspepsia	5.2 (0.6)	6.1 (0.7)
Diarrhea	4.5 (0.4)	3.4 (0.3)
Nausea	3.4 (0.5)	3.8 (0.4)
Metabolic & nutritional disorders		
Hypercholesterolemia	4.0 (0)	4.4 (<0.1)
Musculo-skeletal system disorders		
Arthralgia	6.3 (0.1)	6.2 (0.1)
Back Pain	5.8 (0.1)	5.3 (<0.1)
Platelet, bleeding, & clotting disorders		
Purpura/Bruise	5.3 (0.3)	3.7 (0.1)
Epistaxis	2.9 (0.2)	2.5 (0.1)
Psychiatric disorders		
Depression	3.6 (0.1)	3.9 (0.2)
Respiratory system disorders		
Upper resp tract infection	8.7 (<0.1)	8.3 (<0.1)
Dyspnea	4.5 (0.1)	4.7 (0.1)
Rhinitis	4.2 (0.1)	4.2 (<0.1)
Bronchitis	3.7 (0.1)	3.7 (0)
Coughing	3.1 (<0.1)	2.7(<0.1)
Skin & appendage disorders		
Rash	4.2 (0.5)	3.5 (0.2)
Pruritus	3.3 (0.3)	1.6 (0.1)
Urinary system disorders		
Urinary tract infection	3.1 (0)	3.5 (0.1)

Incidence of discontinuation, regardless of relationship to therapy, is shown in parentheses.
Adverse events occurring in ≥2.0% of patients on PLAVIX in the CURE controlled clinical trial are shown below regardless of relationship to PLAVIX.

Table 5: Adverse Events Occurring in ≥2.0% of PLAVIX Patients in CURE

Body System **Event**	**% Incidence (% Discontinuation)** **PLAVIX (+ aspirin)* [n=6259]**	**Placebo (+ aspirin)* [n=6303]**
Body as a Whole– general disorders		
Chest Pain	2.7 (<0.1)	2.8 (0.0)
Central & peripheral nervous system disorders		
Headache	3.1 (0.1)	3.2 (0.1)
Dizziness	2.4 (0.1)	2.0 (<0.1)
Gastrointestinal system disorders		
Abdominal pain	2.3 (0.3)	2.8 (0.3)
Dyspepsia	2.0 (0.1)	1.9 (<0.1)
Diarrhea	2.1 (0.1)	2.2 (0.1)

*Other standard therapies were used as appropriate.

Other adverse experiences of potential importance occurring in 1% to 2.5% of patients receiving PLAVIX (clopidogrel bisulfate) in the CAPRIE or CURE controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in CURE).
Autonomic Nervous System Disorders: Syncope, Palpitation. *Body as a Whole-general disorders:* Asthenia, Fever, Hernia. *Cardiovascular disorders:* Cardiac failure. *Central and peripheral nervous system disorders:* Cramps legs, Hypoaesthesia, Neuralgia, Paraesthesia, Vertigo. *Gastrointestinal system disorders:* Constipation, Vomiting. *Heart rate and rhythm disorders:* Fibrillation atrial. *Liver and biliary system disorders:* Hepatic enzymes increased. *Metabolic and nutritional disorders:* Gout, hyperuricemia, non-protein nitrogen (NPN) increased. *Musculo-skeletal system disorders:* Arthritis, Arthrosis. *Platelet, bleeding & clotting disorders:* GI hemorrhage, hematoma, platelets decreased. *Psychiatric disorders:* Anxiety, Insomnia. *Red blood cell disorders:* Anemia. *Respiratory system disorders:* Pneumonia, Sinusitis. *Skin and appendage disorders:* Eczema, Skin ulceration. *Urinary system disorders:* Cystitis. *Vision disorders:* Cataract, Conjunctivitis.
Other potentially serious adverse events which may be of clinical interest but were rarely reported (<1%) in patients who received PLAVIX in the CAPRIE or CURE controlled clinical trials are listed below regardless of relationship to PLAVIX. In general, the incidence of these events was similar to that in patients receiving aspirin (in CAPRIE) or placebo + aspirin (in CURE).
Body as a whole: Allergic reaction, necrosis ischemic. *Cardiovascular disorders:* Edema generalized. *Gastrointestinal system disorders:* Gastric ulcer perforated, gastritis hemorrhagic, upper GI ulcer hemorrhagic. *Liver and Biliary system disorders:* Bilirubinemia, hepatitis infectious, liver fatty. *Platelet, bleeding and clotting disorders:* hemarthrosis, hematuria, hemoptysis, hemorrhage intracranial, hemorrhage retroperitoneal, hemorrhage of operative wound, ocular hemorrhage, pulmonary hemorrhage, purpura allergic, thrombocytopenia. *Red blood cell disorders:* Anemia aplastic, anemia hypochromic. *Reproductive disorders, female:* Menorrhagia. *Respiratory system disorders:* Hemothorax. *Skin and appendage disorders:* Bullous eruption, rash erythematous, rash maculopapular, urticaria. *Urinary system disorders:* Abnormal renal function, acute renal failure. *White cell and reticuloendothelial system disorders:* Agranulocytosis, granulocytopenia, leukemia, leukopenia, neutrophils decreased.

Postmarketing Experience
The following events have been reported spontaneously from worldwide postmarketing experience:

- *Body as a whole:*
  -hypersensitivity reactions, anaphylactoid reactions, serum sickness
- *Central and Peripheral Nervous System disorders:*
  -confusion, hallucinations, taste disorders
- *Hepato-biliary disorders:*
  -abnormal liver function test, hepatitis (non-infectious), acute liver failure
- *Platelet, Bleeding and Clotting disorders:*
  -cases of bleeding with fatal outcome (especially intracranial, gastrointestinal and retroperitoneal hemorrhage)
  -thrombotic thrombocytopenic purpura (TTP) – some cases with fatal outcome- (see **WARNINGS**).
  -agranulocytosis, aplastic anemia/pancytopenia
  -conjunctival, ocular and retinal bleeding
- *Respiratory, thoracic and mediastinal disorders:*
  -bronchospasm, interstitial pneumonitis
- *Skin and subcutaneous tissue disorders:*
  -angioedema, erythema multiforme, Stevens-Johnson syndrome, toxic epidermal necrolysis, lichen planus
- *Renal and urinary disorders:*
  - glomerulopathy, increased creatinine levels
- *Vascular disorders:*
  - vasculitis, hypotension
- *Gastrointestinal disorders:*
  - colitis (including ulcerative or lymphocytic colitis), pancreatitis, stomatitis
- *Musculoskeletal, connective tissue and bone disorders:*
  - myalgia

OVERDOSAGE
Overdose following clopidogrel administration may lead to prolonged bleeding time and subsequent bleeding complications. A single oral dose of clopidogrel at 1500 or 2000 mg/kg was lethal to mice and to rats and at 3000 mg/kg to baboons. Symptoms of acute toxicity were vomiting (in baboons), prostration, difficult breathing, and gastrointestinal hemorrhage in all species.
Recommendations About Specific Treatment:
Based on biological plausibility, platelet transfusion may be appropriate to reverse the pharmacological effects of PLAVIX if quick reversal is required.

DOSAGE AND ADMINISTRATION

Recent MI, Recent Stroke, or Established Peripheral Arterial Disease
The recommended daily dose of PLAVIX is 75 mg once daily.

Acute Coronary Syndrome
For patients with acute coronary syndrome (unstable angina/non-Q-wave MI), PLAVIX should be initiated with a single 300 mg loading dose and then continued at 75 mg once daily. Aspirin (75 mg-325 mg once daily) should be initiated and continued in combination with PLAVIX. In CURE, most patients with Acute Coronary Syndrome also received heparin acutely (see **CLINICAL STUDIES).**
PLAVIX can be administered with or without food.
No dosage adjustment is necessary for elderly patients or patients with renal disease. (See **Clinical Pharmacology: Special Populations.)**

Distributed by:
Bristol-Myers Squibb/Sanofi Pharmaceuticals Partnership
New York, NY 10016

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Brief Summary of Prescribing Information Revised February 2006

PLA-FEB06-B-Af

STATEMENT OF OWNERSHIP, MANAGEMENT, AND MONTHLY CIRCULATION OF

NATIONAL GEOGRAPHIC

OWNER AND PUBLISHER: National Geographic Society
GILBERT M. GROSVENOR, *Chairman of the Board*
JOHN M. FAHEY, JR., *President and CEO*
CHRIS JOHNS, *Editor in Chief*
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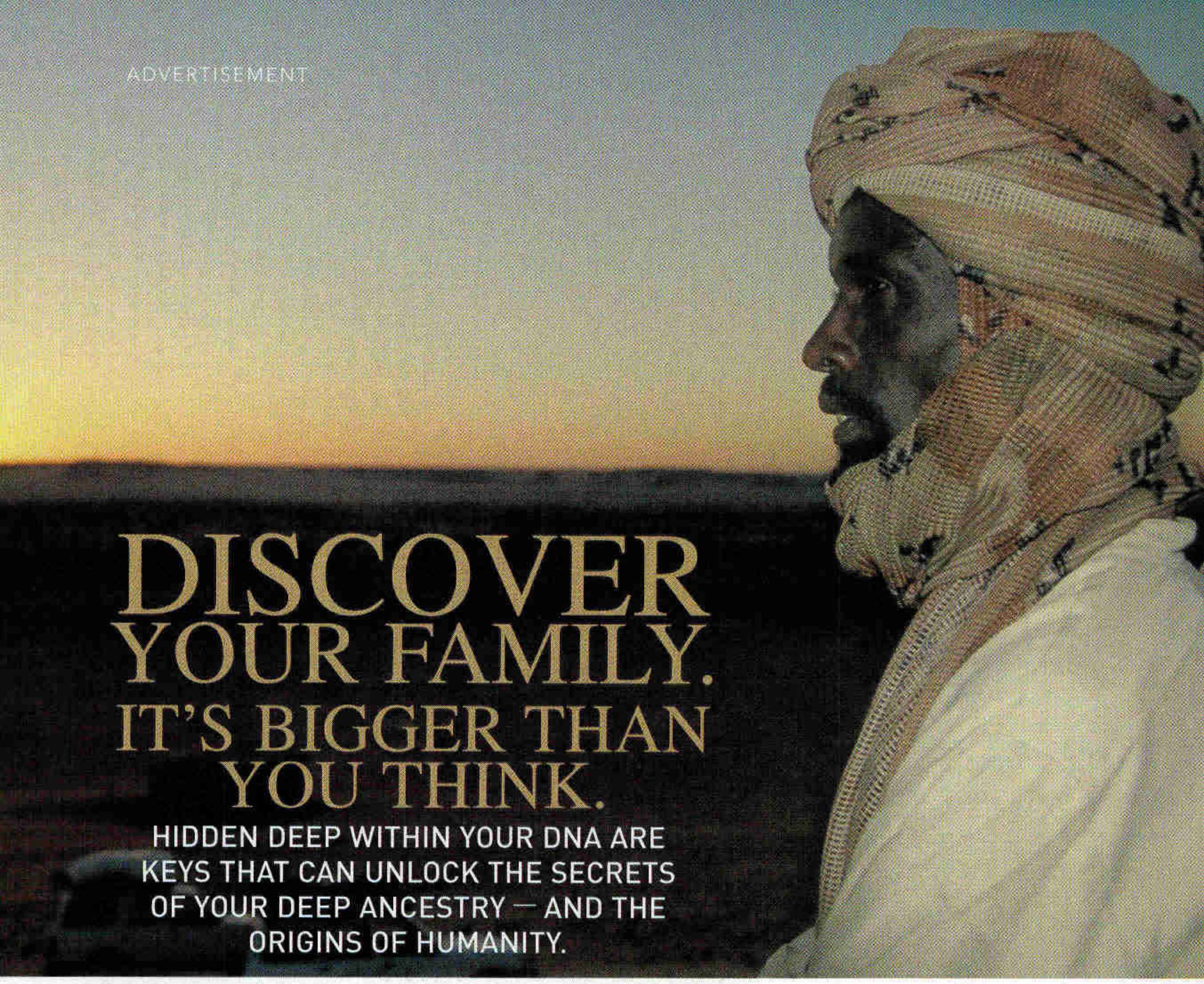
1145 Seventeenth Street N.W., Washington, DC 20036
STOCKHOLDERS, BONDHOLDERS, MORTGAGE, OTHER SECURITY HOLDERS: *None*

	AVERAGE NUMBER COPIES EACH ISSUE DURING PRECEDING 12 MOS.	SINGLE ISSUE NEAREST TO FILING DATE
A. TOTAL COPIES PRINTED	Oct. 2005–Sept. 2006	September 2006
(Net Press Run)	6,596,309	6,521,583
B. PAID CIRCULATION		
1. Outside-County Mail Subscriptions	4,122,549	3,920,926
2. In-County Mail Subscriptions	–	–
3. Single Copy Sales/Non USPS Paid Distribution	1,550,006	1,445,566
4. Other Classes Mailed Through USPS	–	–
C. TOTAL PAID CIRCULATION	5,672,555	5,366,492
D. FREE DISTRIBUTION BY MAIL (includes samples, no news agents)		
1. Outside County	562,044	745,205
2. In County	–	–
3. Other Classes Mailed Through USPS	–	–
D. TOTAL FREE DISTRIBUTION BY MAIL	562,044	745,205
E. FREE DISTRIBUTION OUTSIDE THE MAIL	17,991	11,376
F. TOTAL FREE DISTRIBUTION (Sum of D and E)	580,035	756,581
G. TOTAL DISTRIBUTION (Sum of C and F)	6,252,590	6,123,073
H. OFFICE USE, LEFTOVER, ETC.	343,719	398,510
I. TOTAL (Sum of G and H)	6,596,309	6,521,583
J. PERCENT PAID	91%	88%



DISCOVER YOUR FAMILY. IT'S BIGGER THAN YOU THINK.

HIDDEN DEEP WITHIN YOUR DNA ARE KEYS THAT CAN UNLOCK THE SECRETS OF YOUR DEEP ANCESTRY — AND THE ORIGINS OF HUMANITY.

Join National Geographic and IBM, along with support from The Waitt Family Foundation, on a quest to uncover our common distant past. As part of the Genographic Project a worldwide team of scientists is collaborating with the world's traditional and indigenous people, and participants such as you, to reveal our common migratory path — one that began with the dawn of humanity in Africa more than 60,000 years ago. By sending your DNA through our anonymous process, you will receive the story of your own deep ancestry and can choose to have your results contribute to a more complete picture of the human journey.

Proceeds from your purchase of a Genographic Project Public Participation Kit will benefit the project's ongoing field research as well as education, cultural conservation, and language preservation and revitalization for indigenous and traditional groups through the Genographic Legacy Fund.

Unravel the mystery of your own genetic journey. To give the gift of personal history or to order your own Genographic Project Public Participation Kit, visit www.nationalgeographic.com/genographic.

THE GENOGRAPHIC PROJECT

NATIONAL GEOGRAPHIC™ IBM

A research partnership of National Geographic and IBM

THE WAITT FAMILY FOUNDATION®

Global field science supported by the Waitt Family Foundation

NG EXHIBIT **Instrument of Remembrance** Musician Fats Domino survived Hurricane Katrina, but his home in the Lower Ninth Ward of New Orleans didn't fare as well. Surging waters damaged his house and belongings, including three pianos. Domino donated one of the pianos—a Steinway grand on which he wrote songs—to the Louisiana State Museum. With funding from National Geographic, conservators removed from the instrument the mud, mold, asbestos, and other toxins left by the flood. The ruined piano's remains will eventually become part of a permanent exhibit of Katrina mementos at the New Orleans branch of the museum. Currently it can be seen there through December 31, along with photographs covering the aftermath of the storm.

Katrina Exhibit at the Louisiana State Museum

- **David Burnett's** images of the storm-ravaged Gulf Coast were first published in the August 2006 NATIONAL GEOGRAPHIC.
- **Student photographs** speak to the struggles of New Orleans in the months following Katrina. Snapped by 15 city teens participating in National Geographic's April 2006 New Orleans Photo Camp, the pictures feature scenes from the still tidy sidewalks of the city's French Quarter to the devastated Lower Ninth Ward.

ON ASSIGNMENT **Winging It** Humans rarely set foot on the South Sandwich Islands. So when Maria Stenzel showed up there, a group of local skuas weren't about to miss out on a new landing pad. One became especially enamored of her hat (left). "I have a lot of admiration for skuas," says Stenzel, who also has a lot of experience with the birds: She's covered Antarctica five times for the GEOGRAPHIC. "I think they're gutsy." Thankfully her feathered friend was not defending its nest. Adult skuas, aggressive when protecting their eggs or chicks, are known to attack.

PHOTOS: MICHAEL O'BRIEN (TOP); SARAH PARK

Recycling that's easy to wrap around.

Wrapping yourself around a plan that recycles your used rechargeable batteries is easy. Check the batteries in your cordless and cellular phones, camcorders, cordless power tools, laptop computers, digital cameras, and two-way radios. If they no longer hold a charge, recycle them by visiting one of many collection sites nationwide, including those retailers listed below. For a complete list of rechargeable battery drop-off locations, visit **www.call2recycle.org** or call toll free **877-2-RECYCLE**.

Recycle your rechargeable batteries.

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A Rechargeable Battery Recycling Corporation program

Recycle at one of these national retailers: BatteriesPlus + BEST BUY Office DEPOT RadioShack. Sears STAPLES TARGET

INSIDE GEOGRAPHIC

ON ASSIGNMENT In Iraq When a roadside bomb exploded near a U.S. Army Humvee in central Iraq, military medic unit Charlie 2-4 was quick to respond—accompanied by embedded GEOGRAPHIC writer Neil Shea, far left, and photojournalist Jim Nachtwey, second from left. "The Heroes, The Healing" was Shea's first assignment in war. Not so for Nachtwey, who has covered conflicts around the world and was injured in Iraq in 2003. "I definitely made some withdrawals from the bank of experience that is Jim," says Shea. "He's lived through a lot of close calls. He's been shot at, hit by grenade fragments. Many of the men in Iraq carry good luck charms. I think Jim was mine."

December Contributors

VOICES: CESAR MILLAN, page 32
Cathy Newman, a senior writer, wasn't tempted to consult the dog whisperer about her dog, Skitch. "He's a laid-back Labrador," she says.

BEAUTIFUL STRANGER, page 38
Bill Douthitt has worked on many space stories for the magazine—as an illustrations editor. The senior editor's story on Saturn is the second feature he's written for the magazine.

EARTH IN THE BEGINNING, page 58
Photos evoking Earth's earliest days are part of **Frans Lanting**'s book *Life: A Journey Through Time,* also produced as a multimedia performance with music by Philip Glass.

Senior editor for science, **Tim Appenzeller** often writes about life on Earth for the GEOGRAPHIC.

THE HEROES, THE HEALING, page 68
Staff writer **Neil Shea** spent two months in Iraq with U.S. military units to report this story.

James Nachtwey, a founding member of the photo agency VII, has been photographing war zones since 1981.

BULGARIA'S GOLD RUSH, page 106
Senior writer **A. R. Williams** returned to her early professional roots for her story on ancient Thrace: She is a former archaeologist.

Photographer **Kenneth Garrett** specializes in covering cultural heritage, from human evolution to the origins of civilization.

ICY UNDERWORLD, page 122
Senior writer **Jennifer S. Holland** has covered both ends of the Earth for the magazine. Her "Northern Exposure" ran in January 2004.

Photos from **Maria Stenzel**'s assignments appear in *Women Photographers at National Geographic.*

GHOST BIRD, page 142
If any photographer could track down a woodpecker that might not exist, it would be **Joel Sartore.** He did find one—in a specimen drawer.

Mel White's article about pelicans, "Ungainly Grace," appeared in the June 2006 issue.

Tales From the Field Learn more about our contributors in Features at **ngm.com/0612.**

PHOTO: PHILLIP SINCLAIR

If You Are a Medicare Part B Beneficiary or Heir of a Beneficiary Who Made, or is Obligated to Make a Co-Payment Through Medicare Part B For the Drugs,

Blenoxane *(bleomycin sulfate)*
Cytoxan *(cyclophosphamide)*
Etopophos *(etoposide phosphate)*
Paraplatin *(carboplatin)*
Procrit *(epoetin alfa)*
Remicade *(infliximab)*
Rubex *(doxorubicin hcl)*
Taxol *(paclitaxel)*
VePesid *(etoposide)*
Zoladex *(goserelin acetate)*

A Class Action Lawsuit May Affect Your Rights

There are class action lawsuits pending in the U.S. District Court for the District of Massachusetts. The name of the lawsuits are *In re: Pharmaceutical Industry Average Wholesale Price Litigation*, Docket No. 01-CV-12257-PBS.

The lawsuits claim that certain drug companies intentionally reported false and inflated average wholesale prices ("AWP") for certain types of outpatient drugs. The reported AWPs are used to set prescription drug prices that are paid by Medicare and consumers making Medicare Part B co-payments. The lawsuit asks the Court to award money damages to people who made Medicare Part B co-payments for the drugs. The Court has certified separate Classes against each Defendant. A series of trials will determine the claims against each Defendant. An initial trial involving all Defendants began on November 6, 2006.

What Drugs are Covered by the Litigation?

Certain dosages of the drugs listed above made by the Defendants **AstraZeneca, Bristol-Myers Squibb Group** and **Johnson & Johnson Group** are part of the lawsuit ("Covered Drugs"). For a list of the dosages, by drug, visit the Web site or call or write as indicated below.

What do the Defendants say about the lawsuits?

The Defendants say they didn't do anything wrong. Defendants deny that they are responsible for any of the claims made in the lawsuit and will vigorously defend against these claims. The Defendants deny the factual allegations being made; contend that the lawsuits and damages are precluded under the law; contend that the alleged conduct, if proved, does not violate the 44 consumer protection laws, and that many class members will not be able to prove they paid a doctor for the subject drugs.

Am I Involved in the Litigation?

- You are a member of one or more of the Classes if you made a co-payment under Medicare Part B from January 1, 1991 to January 1, 2005 or have an obligation to make such a co-payment for a Covered Drug, or you are the legal heir of, or legal successor to the rights of a Medicare Part B beneficiary who made such a co-payment.
- You are not included in the Classes if you were a resident of Alabama, Alaska, Georgia, Iowa, Kentucky, Louisiana, Mississippi, Montana or Virginia at the time you made the Medicare Part B co-payment.
- You are also excluded from the Classes if you made flat co-payments (a co-payment that does not differ with the cost of the drug), or you were reimbursed for co-payments or have the right to be reimbursed.

The Court is <u>not</u> suggesting, requesting, or requiring that Medicare Part B beneficiaries who were not billed by their doctors, or who were billed but did not pay, should pay their doctors now or that they are obligated to do so under the Medicare statute.

What are My Rights as a Member of one or more of the Classes?

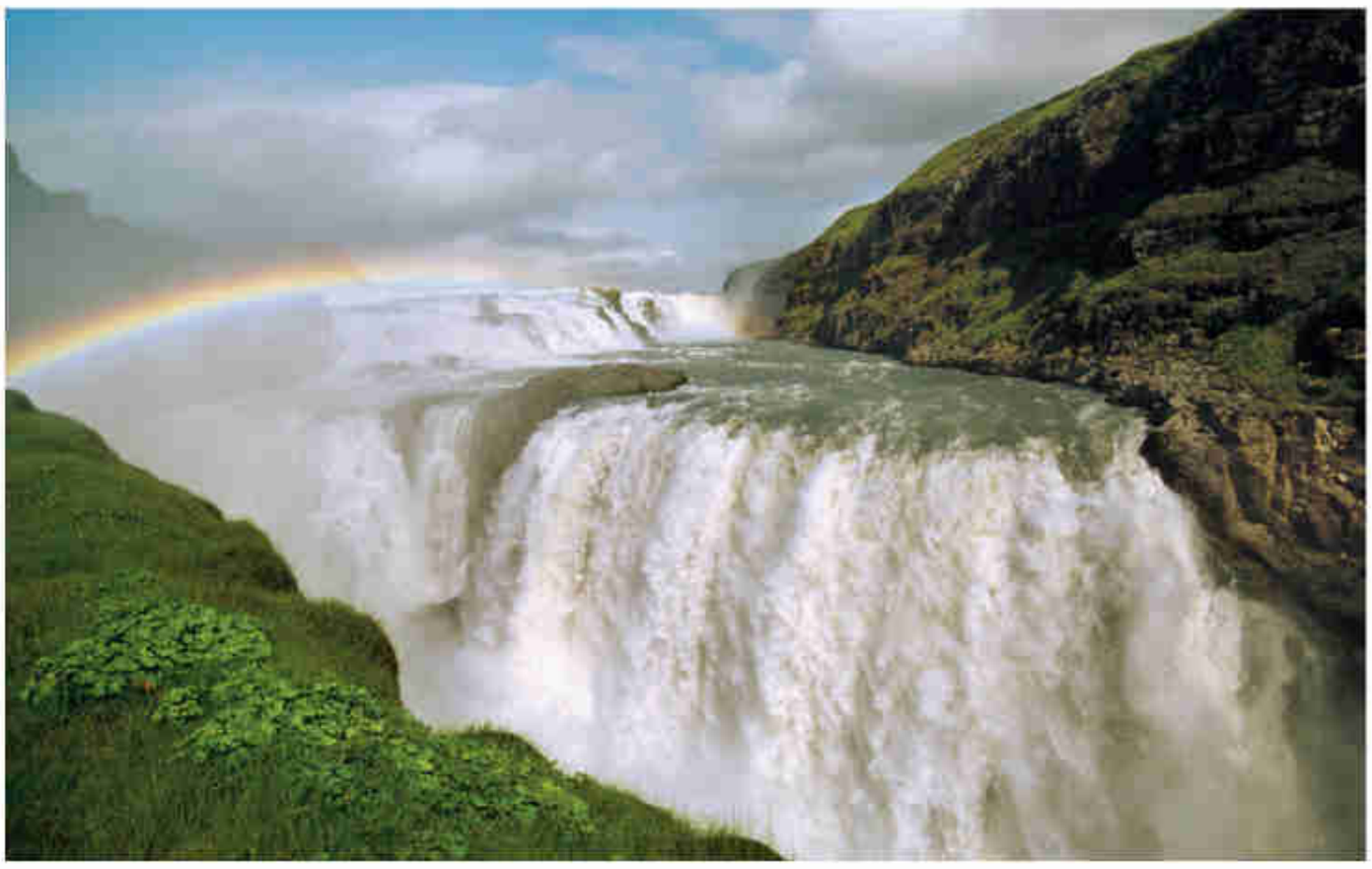
- **If you wish to remain a member of the Classes**, you don't need to do anything at this time. If you don't exclude yourself, as a member of one or more of the Classes you'll be bound by whatever happens in the lawsuit, and you won't be able to sue the Defendants on your own about the claims in the lawsuit. Court-appointed Counsel will represent all members of the Classes and will ask the Court to pay their fees and expenses out of any recovery they achieve for the Classes. You may also hire your own attorney at your own cost to speak or appear on your behalf.
- **If you do not wish to participate in one or more of the Classes**, you must mail a personally signed, written request to be excluded to the address below. A mail-in opt-out form is available at <u>www.AWPlitigation.net</u>. You may also request to be excluded from the lawsuit against one or more Defendants and remain in the litigation against the other Defendants. The request must be postmarked by February 19, 2007. If you exclude yourself from one or more of the Classes the lawsuits will not affect you. This means that you will not share in any recovery, if there is one, but you can sue the Defendants about the same claims.

For a Detailed Notice about the Covered Drugs and AWP Litigation

Call toll-free: 1-866-903-1204 (Se Habla Español) or Visit: www.AWPlitigation.net

Or Write: AWP Litigation Administrator, c/o Complete Claim Solutions, LLC
P.O. Box 24654, West Palm Beach, FL 33416

INSIDE GEOGRAPHIC



NATIONAL GEOGRAPHIC CHANNEL

Amazing Planet How did a Pacific Ocean hot spot form the Hawaiian Islands? How did water and ice sculpt places like Iceland (above)? National Geographic Channel uses computer-generated imaging to answer these questions and more. Watch *Amazing Planet* episodes *Born of Fire, Ocean Realm,* and *Destructive Forces* on December 3 beginning at 8 p.m.

NG KIDS **Kids Visit the Galápagos** Heather Snyder (above) just might be the next Sylvia Earle. She's off to a good start as part of National Geographic's first all-kids expedition. Winners of a photo and essay contest, Snyder and 14 others visited the Galápagos Islands to hobnob with tortoises and sea lions. The contest and expedition, co-sponsored by Purell and National Geographic Channel, and hosted by Lindblad Expeditions, proved such a success that *National Geographic Kids* plans to do it again. Go to *hands-onexplorer.com* to learn about a 2007 trip to South Africa.

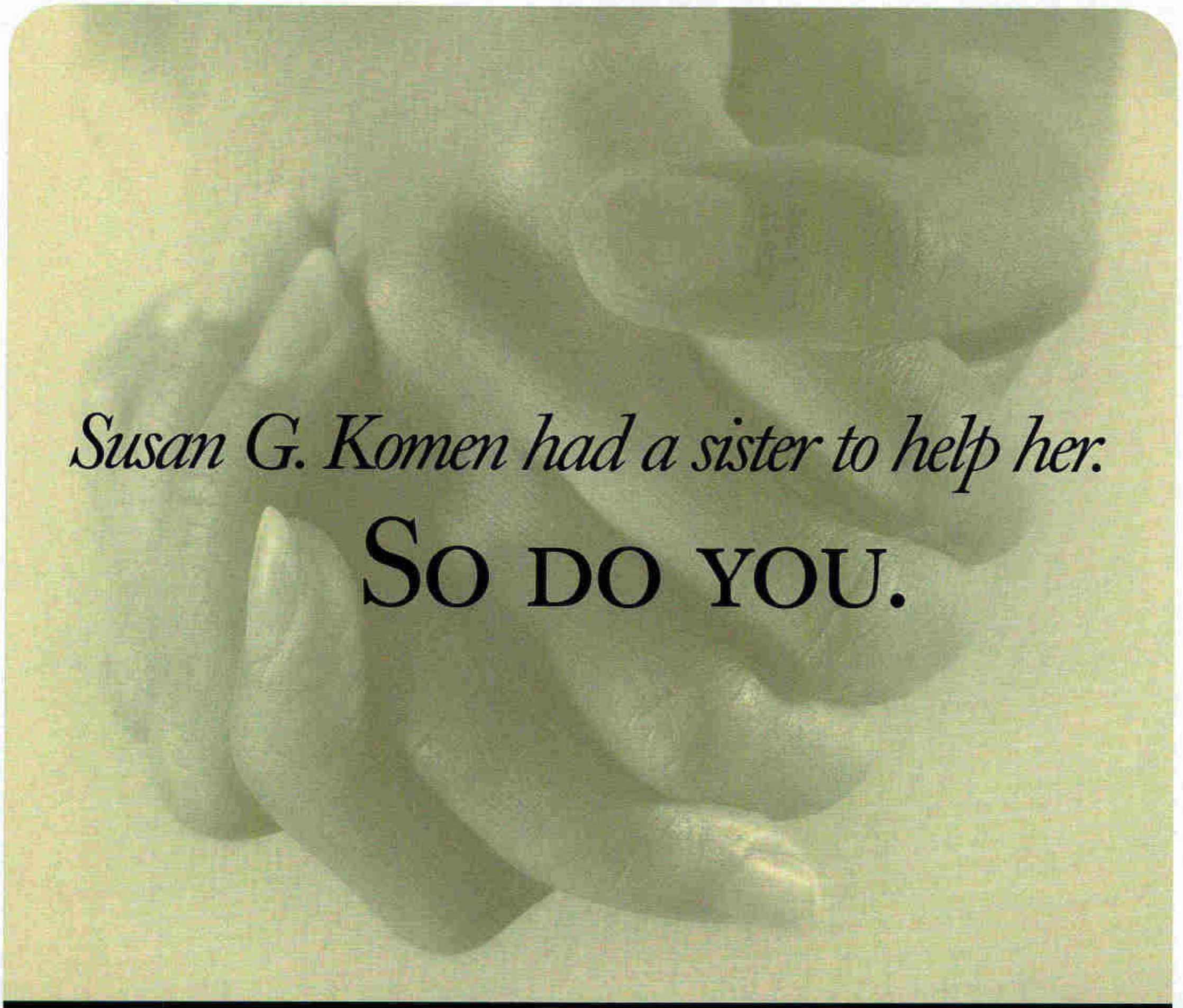
NG Events

The National Geographic Society began its speaker series in 1888. *NG Live!* carries on the tradition. Here are some of the events coming up. For a complete schedule, go to *nglive.org.*

- **Explorer-in-Residence Spencer Wells** updates the Genographic Project in Seattle and Minneapolis in January, and Chicago in February.
- **Banff Mountain Film Festival World Tour** See films from around the world in Washington, D.C., in February.
- **Polar explorer Børge Ousland** discusses his Arctic trek in Washington, D.C., and Seattle in March.
- **Dereck and Beverly Joubert** (below), Society explorers-in-residence, speak in Seattle and Minneapolis in February.

To book tickets for National Geographic events at headquarters in Washington, D.C., call 202-857-7700; at Chicago's Field Museum, call 312-665-7400; at the Pantages Theatre in Minneapolis, call 612-673-0404; and at Benaroya Hall in Seattle, call 206-624-5677.

PHOTOS: FRANS LANTING, MINDEN PICTURES (TOP); ANNIE GRIFFITHS BELT (BOTTOM LEFT); GRAHAM BOYNTON



Susan G. Komen had a sister to help her.

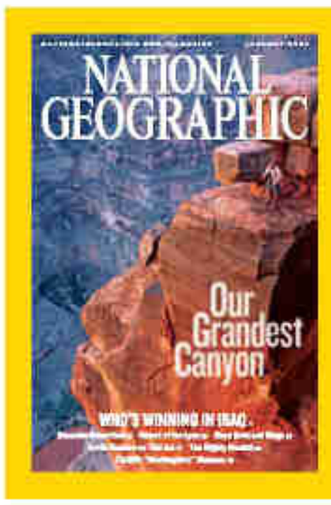
SO DO YOU.

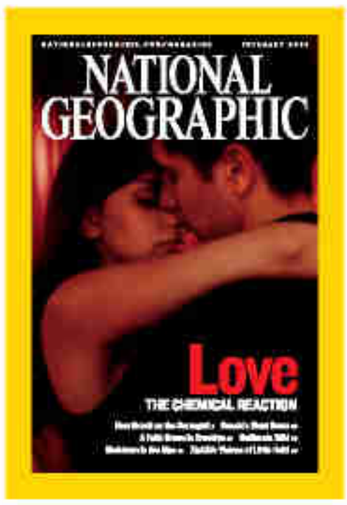
In 18,000 U.S. communities, more than 100,000 Komen Foundation volunteers tend to their sisters, just as our founder tended to hers. Their efforts help fund breast cancer education, screening and treatment programs for those who need it most. That's in addition to the promising research we fund around the world. Yet, because one woman is diagnosed with breast cancer every three minutes in the U.S., help cannot come soon enough.

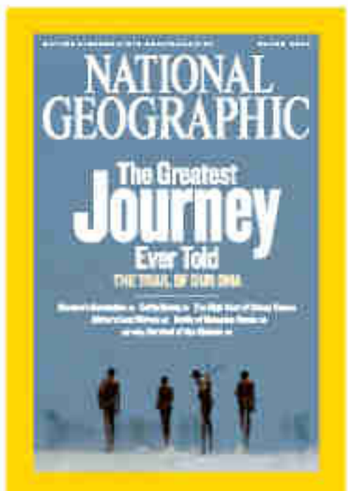
Make every second count. Get involved. Visit komen.org/ng or call us at 1.800 I'M AWARE®.

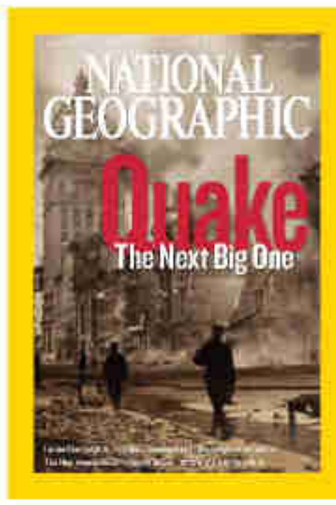
The Susan G. Komen Breast Cancer Foundation

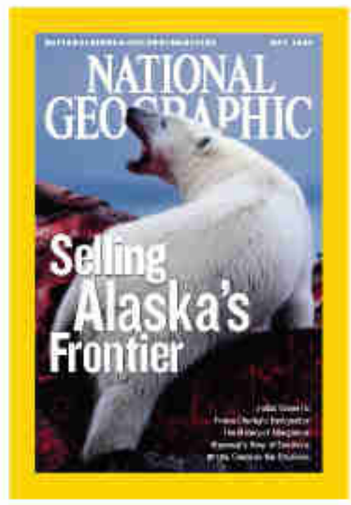
YEAR IN REVIEW | 2006

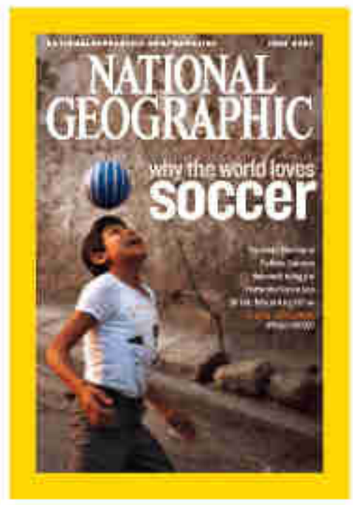


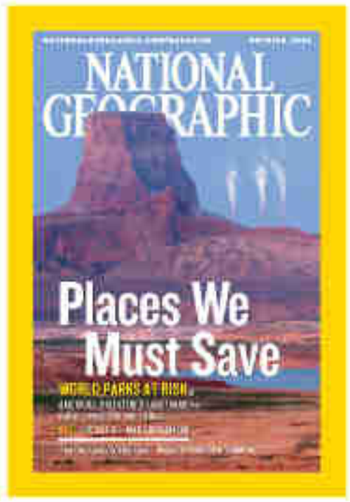


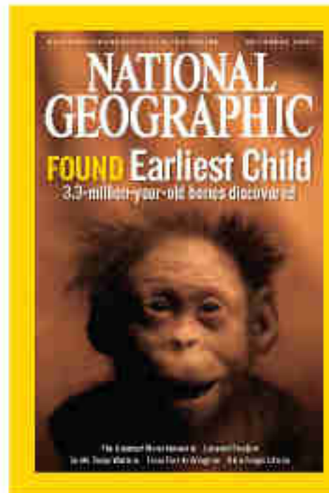


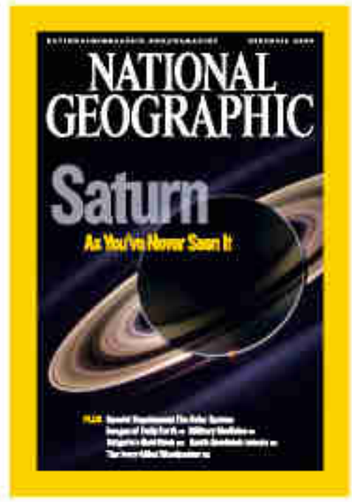












Access the online index to NATIONAL GEOGRAPHIC and other Society publications at *nationalgeographic.com/publications.* A printed 2006 index for NATIONAL GEOGRAPHIC and other Society magazines will be available in March for $6.00 plus postage. To order call 1-888-225-5647 or write NGS, PO Box 6916, Hanover, PA 17331-0916. Place online orders and find 2006 online features at *ngm.com.*

ADVAIR® significantly improves lung function to help you breathe better.*

If you have COPD associated with chronic bronchitis, ADVAIR 250/50 may help.

ADVAIR is different from other COPD medications. ADVAIR is the only product with an anti-inflammatory and a bronchodilator working together to improve lung function.

Get your first full prescription FREE.†
Go to AdvairCOPD.com or call 1-800-987-4900.
Ask your doctor about ADVAIR today.

The way anti-inflammatories work in the treatment of COPD is not well defined.

Important Information: ADVAIR DISKUS 250/50 is approved for controlling symptoms and preventing wheezing in adults with COPD associated with chronic bronchitis. The benefit of using ADVAIR for longer than 6 months has not been evaluated. You should only take 1 inhalation of ADVAIR twice a day. Taking higher doses will not provide additional benefits but may increase your chance of certain side effects. Lower respiratory tract infections, including pneumonia, have been reported with ADVAIR. Patients at risk for developing bone loss (osteoporosis) and some eye problems (cataracts or glaucoma) should be aware that use of inhaled corticosteroids, including ADVAIR, may increase your risk. You should consider having regular eye exams. ADVAIR does not replace fast-acting inhalers for acute symptoms.

*Measured by a breathing test in people taking ADVAIR 250/50, compared with people taking either fluticasone propionate 250 mcg or salmeterol 50 mcg. Your results may vary.

gsk GlaxoSmithKline

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If you don't have prescription coverage, visit pparx.org, or call 1-888-4PPA-NOW (1-888-477-2669)

ADVAIR DISKUS® 250/50
(fluticasone propionate 250 mcg and salmeterol 50 mcg inhalation powder)

If you smoke and want to quit, you can learn more at way2quit.com.

†Subject to eligibility. Restrictions apply. Please see accompanying important information about ADVAIR DISKUS 250/50.

Information about ADVAIR DISKUS

ADVAIR DISKUS® 100/50, 250/50, 500/50

(fluticasone propionate 100, 250, 500 mcg and salmeterol 50 mcg inhalation powder)

What is the most important information I should know about ADVAIR DISKUS?
In patients with asthma, long-acting beta$_2$-agonist medicines such as salmeterol (one of the medications in ADVAIR®) may increase the chance of death from asthma problems. In a large asthma study, more patients who used salmeterol died from asthma problems compared with patients who did not use salmeterol. So ADVAIR is not for patients whose asthma is well controlled on another asthma controller medicine such as low- to medium-dose inhaled corticosteroids or only need a fast-acting inhaler once in a while. Talk with your doctor about this risk and the benefits of treating your asthma with ADVAIR.

ADVAIR should not be used to treat a severe attack of asthma or chronic obstructive pulmonary disease (COPD) requiring emergency medical treatment.

ADVAIR should not be used to relieve sudden symptoms or sudden breathing problems. Always have a fast-acting inhaler with you to treat sudden breathing difficulty. If you do not have a fast-acting inhaler, contact your doctor to have one prescribed for you.

What is ADVAIR DISKUS?
There are two medicines in ADVAIR: Fluticasone propionate, an inhaled anti-inflammatory belonging to a group of medicines commonly referred to as corticosteroids; and salmeterol, a long-acting, inhaled bronchodilator belonging to a group of medicines commonly referred to as beta$_2$-agonists. There are 3 strengths of ADVAIR: 100/50, 250/50, 500/50.

For Asthma
- ADVAIR is approved for the maintenance treatment of asthma in patients 4 years of age and older. ADVAIR should only be used if your doctor decides that another asthma controller medicine alone does not control your asthma or that you need 2 asthma controller medications.
- The strength of ADVAIR approved for patients ages 4 to 11 years who experience symptoms on an inhaled corticosteroid is ADVAIR DISKUS 100/50. All 3 strengths are approved for patients with asthma ages 12 years and older.

For COPD associated with chronic bronchitis
ADVAIR 250/50 is the only approved dose for the maintenance treatment of airflow obstruction in patients with COPD associated with chronic bronchitis. The benefit of using ADVAIR for longer than 6 months has not been evaluated. The way anti-inflammatories work in the treatment of COPD is not well defined.

Who should not take ADVAIR DISKUS?
You should not start ADVAIR if your asthma is becoming significantly or rapidly worse, which can be life threatening. Serious respiratory events, including death, have been reported in patients who started taking salmeterol in this situation, although it is not possible to tell whether salmeterol contributed to these events. This may also occur in patients with less severe asthma.

You should not take ADVAIR if you have had an allergic reaction to it or any of its components (salmeterol, fluticasone propionate, or lactose). Tell your doctor if you are allergic to ADVAIR, any other medications, or food products. If you experience an allergic reaction after taking ADVAIR, stop using ADVAIR immediately and contact your doctor. Allergic reactions are when you experience one or more of the following: choking; breathing problems; swelling of the face, mouth and/or tongue; rash; hives; itching; or welts on the skin.

Tell your doctor about the following:
- If you are using your fast-acting inhaler more often or using more doses than you normally do (e.g., 4 or more inhalations of your fast-acting inhaler for 2 or more days in a row or a whole canister of your fast-acting inhaler in 8 weeks' time), it could be a sign that your asthma is getting worse. If this occurs, tell your doctor immediately.
- If you have been using your fast-acting inhaler regularly (e.g., four times a day). Your doctor may tell you to stop the regular use of these medications.
- If your peak flow meter results decrease. Your doctor will tell you the numbers that are right for you.
- If you have asthma and your symptoms do not improve after using ADVAIR regularly for 1 week.
- If you have been on an oral steroid, like prednisone, and are now using ADVAIR. You should be very careful as you may be less able to heal after surgery, infection, or serious injury. It takes a number of months for the body to recover its ability to make its own steroid hormones after use of oral steroids. Switching from an oral steroid may also unmask a condition previously suppressed by the oral steroid such as allergies, conjunctivitis, eczema, arthritis, and eosinophilic conditions. Symptoms of an eosinophilic condition can include rash, worsening breathing problems, heart complications, and/or feeling of "pins and needles" or numbness in the arms and legs. Talk to your doctor immediately if you experience any of these symptoms.
- Sometimes patients experience unexpected bronchospasm right after taking ADVAIR. This condition can be life threatening and if it occurs, you should immediately stop using ADVAIR and seek immediate medical attention.
- If you have any type of heart disease such as coronary artery disease, irregular heart beat or high blood pressure, ADVAIR should be used with caution. Be sure to talk with your doctor about your condition because salmeterol, one of the components of ADVAIR, may affect the heart by increasing heart rate and blood pressure. It may cause symptoms such as heart fluttering, chest pain, rapid heart rate, tremor, or nervousness.
- If you have seizures, overactive thyroid gland, liver problems, or are sensitive to certain medications for breathing.
- If your breathing problems get worse over time or if your fast-acting inhaler does not work as well for you while using ADVAIR. If your breathing problems worsen quickly, get emergency medical care.
- If you have been exposed to or currently have chickenpox or measles or if you have an immune system problem. Patients using medications that weaken the immune system are more likely to get infections than healthy individuals. ADVAIR contains a corticosteroid (fluticasone propionate) which may weaken the immune system. Infections like chickenpox and measles, for example, can be very serious or even fatal in susceptible patients using corticosteroids.

How should I take ADVAIR DISKUS?
ADVAIR should be used 1 inhalation, twice a day (morning and evening). ADVAIR should never be taken more than 1 inhalation twice a day. The full benefit of taking ADVAIR may take 1 week or longer.

If you miss a dose of ADVAIR, just skip that dose. Take your next dose at your usual time. Do not take two doses at one time.

Do not stop using ADVAIR unless told to do so by your doctor because your symptoms might get worse.

Do not change or stop any of your medicines used to control or treat your breathing problems. Your doctor will adjust your medicines as needed.

When using ADVAIR, remember:
- Never breathe into or take the DISKUS® apart.
- Always use the DISKUS in a level position.
- After each inhalation, rinse your mouth with water without swallowing.
- Never wash any part of the DISKUS. Always keep it in a dry place.
- Never take an extra dose, even if you feel you did not receive a dose.
- Discard 1 month after removal from the foil overwrap.
- Do not use ADVAIR with a spacer device.

Children should use ADVAIR with an adult's help as instructed by the child's doctor.

Can I take ADVAIR DISKUS with other medications?
Tell your doctor about all the medications you take, including prescription and nonprescription medications, vitamins, and herbal supplements.

If you are taking ADVAIR, you should not take SEREVENT® DISKUS or Foradil® Aerolizer® for any reason.

If you take ritonavir (an HIV medication), tell your doctor. Ritonavir may interact with ADVAIR and could cause serious side effects. The anti-HIV medicines Norvir® Soft Gelatin Capsules, Norvir Oral Solution, and Kaletra® contain ritonavir.

No formal drug interaction studies have been performed with ADVAIR.

In clinical studies, there were no differences in effects on the heart when ADVAIR was taken with varying amounts of albuterol. The effect of using ADVAIR in patients with asthma while taking more than 9 puffs a day of albuterol has not been studied.

ADVAIR should be used with extreme caution during and up to 2 weeks after treatment with monoamine oxidase (MAO) inhibitors or tricyclic antidepressants since these medications can cause ADVAIR to have an even greater effect on the circulatory system.

ADVAIR should be used with caution in people who are taking ketoconazole (an antifungus medication) or other drugs broken down by the body in a similar way. These medications can cause ADVAIR to have greater steroid side effects.

Generally, people with asthma should not take beta-blockers because they counteract the effects of beta$_2$-agonists and may also cause severe bronchospasm. However, in some cases, for instance, following a heart attack, selective beta-blockers may still be used if there is no acceptable alternative.

The ECG changes and/or low blood potassium that may occur with some diuretics may be made worse by ADVAIR, especially at higher-than-recommended doses. Caution should be used when these drugs are used together.

In clinical studies, there was no difference in side effects when ADVAIR was taken with methylxanthines (e.g., theophylline) or with FLONASE®.

What are other important safety considerations with ADVAIR DISKUS?
Osteoporosis: Long-term use of inhaled corticosteroids may result in bone loss (osteoporosis). Patients who are at risk for increased bone loss (tobacco use, advanced age, inactive lifestyle, poor nutrition, family history of osteoporosis, or long-term use of drugs such as corticosteroids) may have a greater risk with ADVAIR. If you have risk factors for bone loss, you should talk to your doctor about ways to reduce your risk and whether you should have your bone density evaluated.

Glaucoma and cataracts: Glaucoma, increased pressure in the eyes, and cataracts have been reported with the use of inhaled steroids, including fluticasone propionate, a medicine contained in ADVAIR. Regular eye examinations should be considered if you are taking ADVAIR.

Lower respiratory tract infection: Lower respiratory tract infections, including pneumonia, have been reported with the use of inhaled corticosteroids, including ADVAIR.

Blood sugar: Salmeterol may affect blood sugar and/or cause low blood potassium in some patients, which could lead to a side effect like an irregular heart rate. Significant changes in blood sugar and blood potassium were seen infrequently in clinical studies with ADVAIR.

Growth: Inhaled steroids may cause a reduction in growth velocity in children and adolescents.

Steroids: Taking steroids can affect your body's ability to make its own steroid hormones, which are needed during infections and times of severe stress to your body, such as an operation. These effects can sometimes be seen with inhaled steroids (but it is more common with oral steroids), especially when taken at higher-than-recommended doses over a long period of time. In some cases, these effects may be severe. Inhaled steroids often help control symptoms with less side effects than oral steroids.

Yeast infections: Patients taking ADVAIR may develop yeast infections of the mouth and/or throat ("thrush") that should be treated by their doctor.

Tuberculosis or other untreated infections: ADVAIR should be used with caution, if at all, in patients with tuberculosis, herpes infections of the eye, or other untreated infections.

What are the other possible side effects of ADVAIR DISKUS?
ADVAIR may produce side effects in some patients. In clinical studies, the most common side effects with ADVAIR included:

- Respiratory infections
- Throat irritation
- Hoarseness
- Sinus infection
- Yeast infection of the mouth
- Bronchitis
- Cough
- Headaches
- Nausea and vomiting
- Diarrhea
- Musculoskeletal pain
- Dizziness
- Fever
- Ear, nose, and throat infections
- Nosebleed

Tell your doctor about any side effect that bothers you or that does not go away. These are not all the side effects with ADVAIR. Ask your doctor or pharmacist for more information.

What if I am pregnant, planning to become pregnant, or nursing?
Talk to your doctor about the benefits and risks of using ADVAIR during pregnancy, labor, or if you are nursing. There have been no studies of ADVAIR used during pregnancy, labor, or in nursing women. Salmeterol is known to interfere with labor contractions. It is not known whether ADVAIR is excreted in breast milk, but other corticosteroids have been detected in human breast milk. Fluticasone propionate, like other corticosteroids, has been associated with birth defects in animals (e.g., cleft palate and fetal death). Salmeterol showed no effect on fertility in rats at 180 times the maximum recommended daily dose.

What other important tests were conducted with ADVAIR?
There is no evidence of enhanced toxicity with ADVAIR compared with the components administered separately. In animal studies with doses much higher than those used in humans, salmeterol was associated with uterine tumors. Your healthcare professional can tell you more about how drugs are tested on animals and what the results of these tests may mean to your safety.

For more information on ADVAIR DISKUS
This page is only a brief summary of important information about ADVAIR DISKUS. For more information, talk to your doctor. You can also visit www.ADVAIR.com or call 1-888-825-5249. Patients receiving ADVAIR DISKUS should read the medication guide provided by the pharmacist with the prescription.

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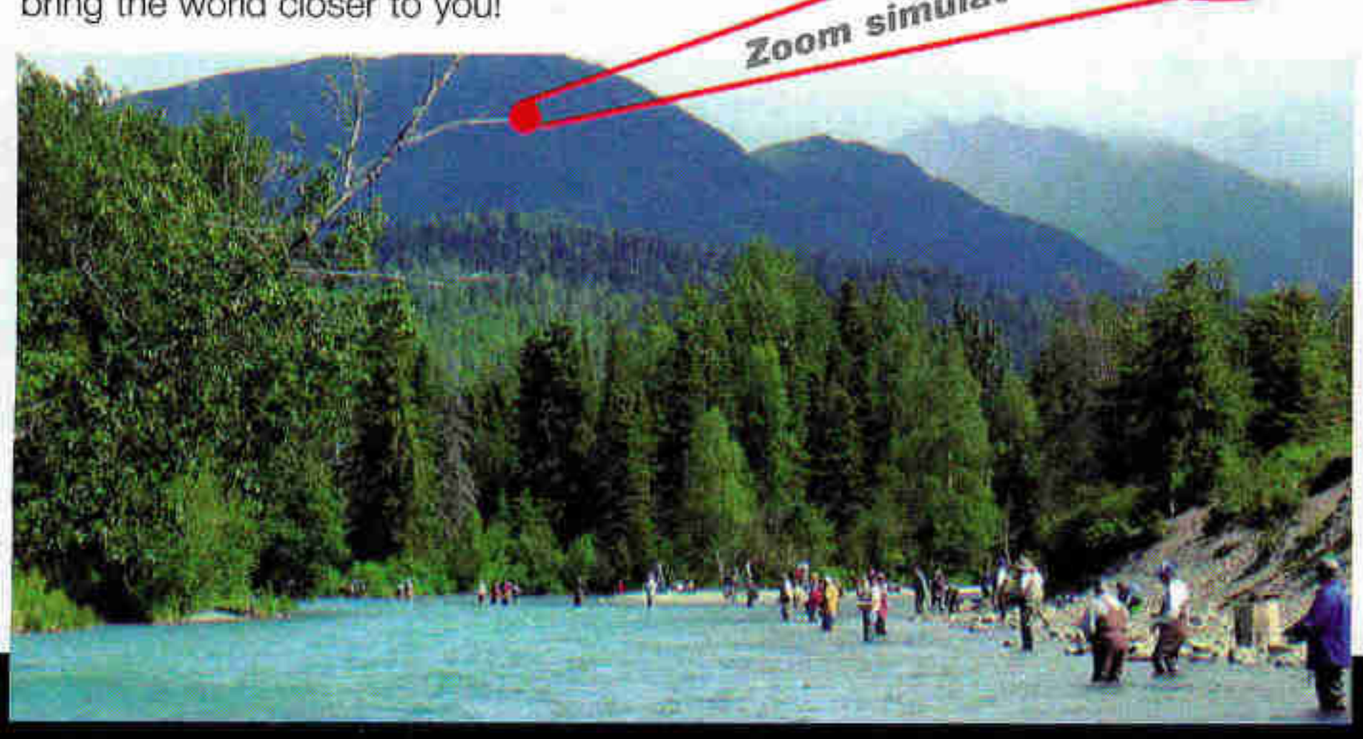

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FLASHBACK

Front Lines A Salvation Army "lassie" writes home for a wounded World War I soldier in 1918. "Ask an American doughboy if life would have been worth living at the front without the Salvation Army cook, comforter, and general utility cheerer," noted a November 1918 GEOGRAPHIC story on war efforts. "Told by the colonel of a regiment that she would be killed if she persisted in serving her doughnuts and cocoa to the men while under heavy fire," one Salvation Army worker said: "'Colonel, we can die with the men, but we cannot leave them.'" *—Margaret G. Zackowitz*

Flashback Archive See all the photos in Fun Stuff at **ngm.com/0612.**

PHOTO: COL. E. J. PARKER

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